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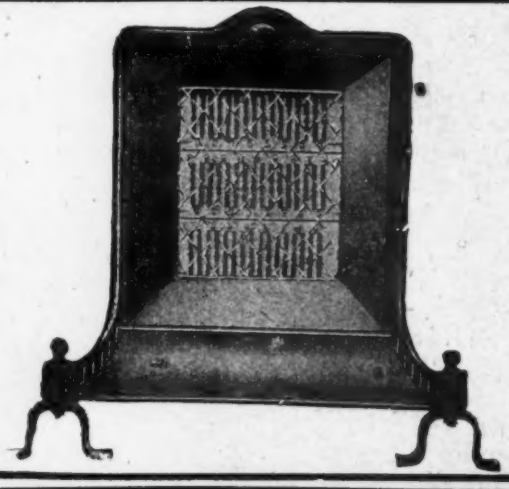

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ELECTRICAL REVIEW.

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THE INDUSTRIAL SITUATION.

DURING the past week or so, in accordance with annual custom, many industrial works in the United Kingdom have been closed for the holidays.

While we were at war in Europe and the factories were places of ceaseless activity in the high-speed production of munitions, it was frequently pointed out that occasional periods of holiday and rest were essential, in order that the workers might be able to pursue their arduous task with fitness and with less industrial irritability and unrest. In more recent times the hours of labour have been shorter and the task less arduous, but the holiday is considered indispensable; in some places it has been lengthened. A general holiday is not unacceptable to those responsible for the direction of industrial manufacturing works where the pressure of orders has fallen off or where the ban on overtime has made overhauling and repair operations impracticable without a complete shut-down for carrying out such work in day-time, though in some cases even repair work during the holidays has been prohibited. A period of reflection is also beneficial to all ranks for the purposes of mental overhaul.

In many works the holiday period is now ended or ending, and there will be a resumption of productive activity; but, unfortunately, there is coming in from various industrial centres a good deal of disquieting evidence showing that unrest is far too general, while there is also much discussion concerning slackening trade and the outlook for the coming winter. We are, further, faced with Lord Haig's righteous demand on behalf of nearly two hundred thousand men from the Forces who have no work to do to-day and no prospect of any to-morrow.

On the part of the employing interests there has lately been a marked weariness with the continuous uncertainty of everything. It hangs over all business, restricts enterprise, limits confidence—that important factor which has always made for prosperity, just as the lack of it has generally preceded the slackening of trade—and forms a gnawing anxiety. Government taxation and lack of financial assistance from the banks contribute to the depression occasioned by the uncertainty.

On the part of the employed there is with us in a somewhat menacing shape a widespread wage-increase demand, while, on the other hand, a growing army of unemployed clamours for the opportunity to work. The relative wages of skilled and unskilled are still a source of grievance and discontent.

It is stated that the inability of engineering and other employers to give firm quotations, due to the foregoing wage uncertainty, has caused many contracts to be placed with American and other foreign competitors. The Sheffield Chamber of Commerce has issued a memorandum warning of the grave injury caused to British trade, and especially to our export trade, by manufacturers finding it necessary to stipulate for prices ruling at the date of delivery. "It

is unreasonable to expect foreign buyers abroad to give *carte blanche* to their suppliers in this country to ship goods at unknown prices." The root of the trouble, says the Sheffield memorandum, is the constant demands, without proper notice, for wage increases. It seems that the practice has become general of demanding immediate advances, and, in some cases, making them retrospective.

In some trades manufacturers have had to notify considerable advances in cost, owing to wage increases, after contracts have been accepted, and cancellation of orders has followed.

The engineering, foundry and shipbuilding trades have their own particular problem awaiting solution, and conferences have been held. Impatience with the decisions of the Industrial Court occasions the desire for the termination of this tribunal for settling wages. In the ordinary course, the agreement relating to it ends when the Wages (Temporary Regulation) Act expires on September 30th. The prevailing disposition is to have done with the four-monthly hearing agreement made in 1917, and to resume direct negotiations between the employers and the employed. Time will prove whether the permanent interests of industry will be adversely affected by such a resumption. Probably they will not, but we are not inclined to assume the cloak of prophecy.

While we see no useful purpose in magnifying the difficulties of the present situation, it would be folly to fail to take due note of the facts. They are sufficiently disquieting, and it were unwise to encourage a spirit of apprehension which can only add to the want of confidence and precipitate economic disaster.

In our opinion we are suffering directly from the unsettlement of affairs in Europe. This has upset all calculations of prophets of the year before last, and early last year, who told us how many years of industrial prosperity we might expect to enjoy before the inevitable period of inactivity and distress arrived. We have done with prophets in these days, whether politicians or economists—temporarily we have little use for them, for there have been so many unknown factors cutting across their forecasts that it were perhaps better if we had never listened to them. We are afraid that they too readily assumed a world at rest from strife—a millennium.

The facts of the situation—not the hopes and promises of prominent orators—are what we have to deal with to-day. The cost of living shows no inclination to fall—indeed it seems bound to go the other way for some months to come, in consequence of the Government efforts to straighten out railway finances, withdraw subsidies, and put house rents on an economic basis. Wage questions are restricting business in trades which normally should have had a long period of prosperous activity; the improved wages and conditions are enjoyed by some with the immediate consequence that expenditure on new work at home is rendered prohibitive, and thousands of would-be workers are out of employment and earn no wages at all; foreign producing countries are getting into their stride, and imports are coming to these shores and to other parts of the Empire and to foreign markets, at an increasing rate; there is reported to be almost everywhere throughout the world a deplorable and demoralising disinclination to work.

One must not be blamed for wondering whither we are tending. We are floundering in the refuse that the war has left behind it, pre-occupied with the muck-rake, turning over rivalries and self-interests, so that we lose sight of the golden crown. Instead of sinking our differences and joining all our forces together in industrial partnership to pull things round, we are chaotically pursuing our own selfish ends, and the new world that a Premier promised, at a date which he subsequently said he had left open, has not yet been born. Possibly all the disquieting movements of the moment are but the pains of labour preceding the delivery of the mouse of the mountain. We shall bring in no new world either by hope or by prophecy. It can only come from within the individual heart and from the united practical effort of all in the nation acting under the inspiration of a lofty vision.

LOAD FACTORS AND STATION EFFICIENCY.

The importance of a good load factor in reducing the cost at which electricity can be produced is so well known that there appears to be a considerable risk of the actual effect of this factor being misunderstood. It is very evident that the higher the load factor for a given output, the less will be the cost of capital and of labour per unit generated, and it is often assumed, in a vague sort of way, that the fuel consumption per unit will also be reduced. This belief appears to be quite unjustified. Of course, if in a given plant the load factor is improved by filling up the hollows of the load curve, the operating efficiency will be increased, but this increase is only due to the extra load, and not to the improvement of the load factor. It would, in fact, have just the same beneficial effect, so far as the coal bill is concerned, if the extra load came right on the top of the existing peak, as if it came during a time of less activity. The load factor, *per se*, has no influence whatever upon the coal consumption of the plant per kilowatt-hour.

We should not have thought it worth while to point this out were it not for the fact that misunderstanding is prevalent on the subject. In his recent paper on "Power Station Design in Relation to Thermal Efficiency," read before the Incorporated Municipal Electrical Association at the Bradford Convention, Mr. I. V. Robinson fell into the error to which we have referred, and as his remarks in this connection passed unnoticed in the discussion, it seems advisable to draw attention to the fallacy. He accepts the fact, demonstrated by Mr. R. H. Parsons in these columns, that for all steam power stations it is possible to establish a straight line law connecting the fuel consumption with the total daily output of the plant, and claims that such a relationship "allows the fuel or heat consumption to be calculated for all daily load factors." As a matter of fact, it does nothing of the kind. What it does do is to enable the fuel or heat consumption to be calculated for all daily outputs, which is a very different thing. If the straight line law is accepted as correlating total output and total fuel consumption over a shift, a day, or for any other period, the load factor during the period in question can have no influence on the efficiency one way or the other. It follows from the very nature of the straight line law that if a station with an output of, say, 100,000 KW.-hours per day, uses a certain amount of coal per KW.-hour, the coal consumption will not be altered, whether the load factor be 1 per cent. or 100 per cent. It is very clear that Mr. Robinson did not realise this fact, for he expresses it as his opinion that a modern power station "with a daily load factor of 40 per cent. to 50 per cent." should aim at a heat consumption not exceeding 20,000 B.TH.U. per KW.-hour. If such a figure can be reached in any station, it will be found that it is dependent upon the total daily output only, and that with a given output it can be repeated, whatever the load factor may be.

We notice a similar misapprehension concerning the effect of load-factor upon thermodynamic efficiency running through an article by Mr. E. R. Briggs, which appears in the current number of the *English Electric Journal*. In this article Mr. Briggs starts from what he terms the "Parsons law," and proceeds to develop curves purporting to show the performance of power stations at various load-factors. But as all these load-factors relate to conditions in which the maximum load is the same, any change in load-factor really connotes a change in total output. What the curves really show, therefore, is how the efficiencies of stations vary with varying output, and the fact that, under the assumed conditions, the load-factors vary at the same time is quite immaterial.

To prove that, if the Parsons law is true, the coal consumption of a station is unaffected by the load-factor, we will consider the case of the Canadian station to which Mr. Briggs refers. The law for this station, at the time the conditions were investigated, was as follows:—

$$C = 20{,}000 + 2{\cdot}917\ K,$$

where C is the total coal burnt per eight-hour shift, expressed

in pounds, and K is the total units generated during the same period.

We will assume that on any particular shift the output is 16,000 KW.-hour, and that the load-factor is 50 per cent. Such a load-factor might be obtained by a load of 4,000 KW. for four hours, and a zero load for the remainder of the shift. We see from the formula above that the total coal consumption for the first half of the shift would be $10,000 + 16,000 \times 2{\cdot}917 = 56,672$ lb., while for the latter half it would be 10,000 lb. Hence, for the whole shift, 66,672 lb. of coal would be burnt, or 4·167 lb. per KW.-hour.

Now let us assume that the load factor is 100 per cent., which is equivalent to a steady load of 2,000 KW. throughout the shift. The coal consumption will now be $10,000 + 8,000 \times 2{\cdot}917 = 33,336$ lb. for either half of the shift, or a total of 66,672 lb. for the whole shift, which is the same as before. Thus, for equal total output, we find that the coal consumption remains the same, whether the output is obtained on a load factor of 50 per cent., or on one of 100 per cent. Precisely the same reasoning will hold good, if the yearly load factor, rather than the load factor per shift, is considered. Hence, one is justified in the conclusion that, so far as coal consumption alone is concerned, any extra load is just as useful on the top of the peak demand, as it is during the hours when the station is running light. Whether it is equally welcome, is, of course, quite another matter.

We have dealt with the question of the effect of load factor upon efficiency at some length, because we wished to correct a false impression which seemed to be gaining ground. The straight line, or "Parsons" law appears to be of such general application and, as shown in the little book on "Coal Consumption of Power Plants," published by this office, so many really useful deductions regarding power plant operation can be drawn from it, that we should regret to see it discredited by unwarranted inferences.

Extra-Long-Distance Transmission.

The phrase "extra-high-tension" is frequently used as a convenient means of discriminating between ordinary high voltages and the much higher pressures used for bulk transmission of electrical energy, but the term has also been used extensively for all pressures exceeding 3,000 volts, which is distinctly a low pressure as judged by modern practice in the transmission of electrical energy. Already pressures of 100,000 volts, and distances of transmission of 100 to 200 miles, are almost commonplace, and we are badly in need of an expressive phrase to describe such installations. Duplicated superlatives are not satisfactory—as witness the Best, Best-Best, and Best-Best-Best of the iron trade—but we may very reasonably adopt the term "extra-long-distance transmission" to cover the transmission of electrical energy over distances exceeding 200 miles, such transmission being an achievement made possible, under the conditions for which it is likely to be required, by the so-called quarter-wave and half-wave systems described elsewhere in this issue.

These systems employ transmission lines, the characteristics of which are such that the time taken for an electrical impulse to flow from one end of the line to the other is one-quarter of the periodic time of the current in the quarter-wave system, and one-half of the periodic time in the half-wave system. The velocity of electricity—so high that the time of propagation may be neglected in all ordinary transmission and distribution problems—here plays a part of primary importance. Another startling fact is that the quarter-wave line is in resonance on light load. It will, indeed, be strange if resonance—hitherto regarded as the particular *bête noire* of the transmission engineer—should prove to be the means of extending 10-fold the economic radius of transmission of electrical energy.

Only the basic principles of quarter-wave and half-wave transmission lines are as yet understood, and there are many difficulties to be overcome before these systems can be utilised in practice. At least for the quarter-wave system a suitable alternator must be designed for constant-current variable-voltage operation, and the inherent magnitude and risks of the whole scheme will demand no small amount of courage on the part of the pioneer. On the other hand, these difficulties and risks are no greater than those which have already been encountered and overcome in electrical transmission practice, and, whatever may be the practical future of the quarter-wave system, the remarkable properties of the latter cannot fail to interest every electrical engineer.

The Importance of Empire Communications.

We do not know that the general public takes much interest in the proceedings of the Imperial Press Conference, which opened in Canada last week. To newspaper men, however, and to all who are consistently zealous for securing the one-ness of the British Empire, they make a direct and imperative appeal. Naturally, when Pressmen from all parts of the Empire meet together, they confer upon many matters of purely mutual or domestic concern, but the Press exists to perform a great public function, however much it may, under individuals, have fallen into line with the commercialism of the age, and, therefore, the proceedings, in the main, have a world-wide influence. Penny postage, in years gone by, was hailed as a boon, and its pioneers were public benefactors to whom monuments were erected. To-day we double the rate and pay homage to those who discover this and other misguided ways for helping us to bear our national financial burdens. Dreams of a universal penny-postage have now gone for a generation, and it remains to be seen whether the increased cost will lessen correspondence between ourselves and our kith and kin beyond the seas. If it does so, the moderate financial advantage will have been gained at a substantial cost, for, in our opinion, oft expressed here, few things are of greater importance in connection with the maintenance of the unity of the Empire and the utilisation for the good of all of the vast resources thereof, than the greatest possible freedom in communication. At the present time, there is an astounding want of frequency and regularity of mails between the Mother Country and certain distant parts of the Empire.

The Imperial Press Conference at the Canadian meeting has again expressed its views regarding the urgency of the need for providing improved facilities for the telegraphic transmission of news within the Empire, the institution of cheaper cable rates, the fullest reasonable utilisation of wireless telegraph and telephone facilities now, and their extended use as they develop. The submarine cable companies are laying new cables and adopting other improvements, but the newspaper men are so impressed with the need for greater accommodation and cheaper rates that one of their chief spokesmen (Mr. Robert Donald) advocated a competing cable service between Great Britain and the Far East. We are afraid that in these days suggestions for a universal cable rate for the British possessions of a penny a word are not worth serious attention; there was a feeling among some delegates that a resolution asking merely for a speedy and better cable service was more likely to be listened to. The policy urged upon the Conference was to aim high, and everybody who takes the long view will agree that our ambition must be the provision of electrical means of communication on the amplest scale and at the lowest possible cost to all parts of the Empire, for that is one of the great essentials for the maintenance of the well-being of the British race and for the development and utilisation of the vast resources which lie awaiting enterprise and effort. In the course of the discussion the ridiculous use of the existing cables for Government messages was blamed as being responsible for some of the congestion on the lines and the delays to which other messages are subjected. Sir Roderick Jones says that the Government use of the cables is as bad now as during the war, and we believe that he is in a position to know. The urgency of Government messages was understood while war conditions prevailed, but even then they were, we believe, needlessly detailed; officials seated in places of government authority should be made to understand that to-day there are other claims quite as imperative as theirs, and thoughtless or wanton use of telegraphic facilities should not be permitted.

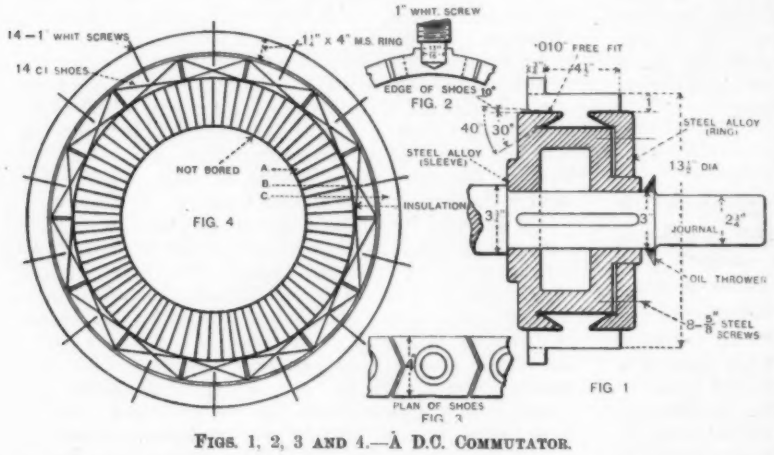
D.C. COMMUTATORS: CLAMPING, TURNING AND RE-TURNING.

By A LONDON FOREMAN.

Foreword.—With a multitude of products, either mechanical or electrical, it is a case of "different firms, different methods," in respect of the manner in which commutators of generators and motors are produced.

The writer, a machine-shop foreman, has no hesitation in asserting that there are firms whose mechanical accessories of electrical machines are produced by electricians, and with distinct disadvantage. Other concerns there are, which place the production of such mechanical accessories under the care of mechanics—not electricians. The latter provision, all who understand will agree to freely, for with all due respect to the electrician, it by no means follows, because he is such, that he is a mechanic.

For instance, the writer was engaged some few years since as mechanical foreman to a large concern manufacturing D.C. motors for electric passenger lifts. An electrical foreman was head of the department, while the writer was second. The concern had been building generators and motors for many years, but how on earth they were able to compete in the open market is a mystery yet. It was this way:—A man built a commutator (how it was built will be told shortly), and as turning a commutator for its sleeve and ring was assumed to be such a particular piece of work, and exclusive to anybody but an electrical man, he was allowed to take his built-up and clamped commutator to the turnery; where, with a considerable amount of



FIGS. 1, 2, 3 AND 4.—A D.C. COMMUTATOR.

preparation and not a little "show," he turned the recesses in the copper for the sleeve and the ring respectively, but took about as much time to do one, as should have been sufficient for about five. There was no complaint from the heads; all was accepted as "necessary and proper."

But was it? The copper was turned at a speed of 40 ft. per minute, while 240 would have been much nearer the proper speed, and besides a regular turner would have beaten the electrician's time to a frazzle, as will be readily understood.

It is, therefore, advised that the section that deals with the copper and the mica should build the commutator and clamp it, and that the turning for sleeve and ring should be done by the regular turner. If a dozen, or a score, or fifty, or a hundred, can be built, and clamped, and sent to be turned in batches, all the better, for in such a case, the machine-shop boss is well able to keep a set of men on the work of commutator turning, and the men, *and the boys*, too, will easily become proficient at the work, and turn them out inexpensively and well.

Though it is true that in connection with the turning of a commutator, both separately and when attached to its armature, there are certain simple rules (as regards cleanliness, &c.), which do not obtain in respect of the regular work of a turnery, all is extremely simple and the rules easily grasped and fully learned.

Commutator Design and Clamping Rings.—The design and construction of the clamping accessories, which are intended to closely constrain the number of copper and mica sections which compose a commutator into a reasonably hard and endurable mass, has a considerable influence on the endurance, the general behaviour and cost for repairs of such commutators. A commutator, well designed, and properly clamped for turning the tapered keeps, and efficiently constrained by its sleeve and ring, will, other things being equal, last much longer, behave better under operation, and will cost much less for upkeep and repairs than one which has been unwisely designed, wrongly, clamped, and has its sleeve and ring so disposed (as some are) that their construction absolutely prevents the constraining of the copper sections, and defeats the purpose for which the tapered form at the ends of the copper sections of the commutator have been designed.

There is nothing at all new in the statement that the primary object of a commutator clamping set is to secure a combination of alternate copper and mica strips, disposed ring-wise "hard and tight" into a circle. It is of interest, however, to observe how far the common methods are successful.

How often does one see (*vide* Text Book) when readers are being told how to design and construct commutators, "The (ring of) sections are gripped end-wise between two rings, having projections of equal form of the reverse of the recesses turned in the sections. When these rings are pulled together tightly, the projections of the rings entering the recesses previously turned in the ring of copper sections, constrain these sections into a hard and endurable mass."

This instruction, which does not presume that the commutator sections have been previously squeezed up tightly, is responsible for the hundreds of slack commutators there are, and one might as well expect a boiler to be tight without "plating" as a commutator to be tight without previously being pressed into a hard mass ere the end recesses are bored to receive the sleeve and the ring.

Were it that the only task of the recesses in the sections and the projection on sleeve and ring respectively, was to hold the sections axially, the angles at which the recesses should be bored and the projections turned would matter but little. But even with the most perfectly-pressed commutator it has been found necessary to provide means whereby the sections may be further constrained and assisted towards a continued hardness after the machine to which the commutator is attached has been put into regular service, and it is noticeable that leading makers, in company with a well-known Silvertown company of the writer's acquaintance, provide for this need of continued hardness, with such excellent results that commutators so provided *run for years without being touched.*

A commutator is either a good one or a bad one; if a good one it will give no more trouble than a "fast" pulley, and certainly less than a "loose" pulley. If it is a bad one, loosely built and inefficiently constrained, there is no remedy but scrapping and rebuilding it, and time and cost and unending trouble will be saved by so doing.

Approved Design of Commutator and Means of Construction.—Attached are sketches of the writer's design of a D.C. commutator and means of primary construction of the copper sections.

Conjointly with the necessary qualities of hardness and durability, economy of copper must be strictly observed. In this direction there must be sufficient material (and only sufficient for constructing strength) at its inner diameter, and a sufficiency of material at its outer diameter to allow for the commutator to be turned up several times ere it is necessary to renew it. How much is left for this latter

purpose is decided by the maker of the machine; if wise, he will provide a liberal amount.

In the design, while economy is observed in respect of the inner diameter, a liberal amount has been allowed for re-turning.

In the order of Nos. 1, 2, 3, and 4 are given the commutator (with its sleeve and ring), the edge of the clamping shoe, a plan of the shoe, and the method of constricting the copper sections A into a hard mass, by means of the 1¼-in. and 4-in. mild steel ring, and the 14 cast-iron interlocked shoes, and the 14 1-in. diameter Whit. set screws.

When assembling for constriction the shoes are insulated from the copper sections, so that insulation of the sections may be tested, while the commutator is in the lathe, for the purpose of having the V grooves bored for the sleeve and ring.

This is a necessary provision, for it is quite easy for the copper to "span" the mica space and cause "shorts" while the V grooves are being bored.

After nipping up the sections by means of the ring C, and the shoes B, and the 14 1-in. diameter Whit. screws as tightly as it is reasonably possible to do with hand and spanner, the commutator and clamping gear complete, is baked in a vacuum. The coefficient of the copper being greater than that of the steel clamping ring, the copper expands more than the ring. It cannot expand to a larger diameter, so it is compelled to do so centripetally, and is hardened. The 14 screws, which were heretofore as tight as possible, can now be pulled up about another half-a-turn. The commutator is now ready for the grooves to be turned in, and the formed mica rings, which have been provided for insulating the copper sections from the sleeve and the ring respectively, are used as gauges to bore the grooves to.

The grooves being bored, the turner's work is done, and the commutator is sent to the electrical section to be tested for "shorts," and to be attached to its sleeve and ring.

Being pulled up tightly by means of the provisions made in the particular design of sleeve and ring, the sleeve is fitted on to the armature shaft, and the electrical work of connecting the commutator lugs to the armature is completed, the whole is sent again to the turnery, for the commutator to receive its first turning.

Turning the Commutator.—This is brought to the turnery, all complete with the spider, the core, and the armature winding. In some shops it comes with as much pomp and ceremony as a corpse is taken to its burial, with all and sundry looking on. In other concerns, a thousand kilowatt armature weighing over five tons—one, two, and sometimes three in a day—come along, are popped in the lathe, and the "coms" are turned as a part of a day's work.

There are, however, simple rules to be observed, and they are imperative, too, as before stated.

Absolute cleanliness and immunity from the usual products of a machine shop, such as iron turnings or borings, is by no means one of the least observable rules. So the armature is tightly bound with clean hemp sacking, and carried in a clean wood cradle, the weight resting on a solid part of the armature, such as the end-plates or the binding-bands.

It is lifted into the lathe with an expanded rope sling, and is raised to the exact height of the lathe centres by a screw connection between the crane-hook and the sling that carries the load.

The shaft now loaded in centres, the truth of the journals is tested with a dial indicator, and if found to be "dead true to a turn," and the winding protected from copper turnings and dust, the turning of the "com" is proceeded with, with a sharp-pointed no-rake tool at a rotating speed of about 300 ft. per minute. Two or three cuts are taken at about 120 ft., and then the "com" is buffed with glasscloth attached to a wood sector, cut with a radius corresponding to that of the commutator. This operation being completed, the armature is sent to the testing-house and run for trial.

After this primary trial it comes to the lathe again—the "com" is tightened up and turned again. A further test is taken. It comes usually to the lathe a third time, and the final turning is done, and an extra finish put on with the buffing arrangement. There is, as in many other tasks, nothing in it—when you know how; but unless it is done on the lines advocated above, a good, sound, enduring commutator cannot result.

HINTS ABOUT HOUSE BELLS.

By "VOLTMAN."

It is not so much a matter for surprise that the average suburban house bell "goes wrong" now and again, as that it works at all! There are those who put up bells and circuits who would seem to have a profound contempt for Ohm's law or any other electrical laws whatever.

Of the many experiences of the "cheap and nasty" bell installation, the writer has had one which was uncanny, in that the front door bell would, on occasion, ring vigorously at dead of night or early morning. No human hand had pressed the button, and the only way to stop that bell ringing was to get out of bed and disconnect a battery wire. Investigation showed that the two wires from the push, just where they entered the zinc tube, had worn through the insulation, and there was a "touch and go" short-circuit on to the zinc tube, and a little vibration from the street was enough to close the circuit. Judicious application of a few turns of insulating tape to the wires cured the nuisance. This bell, like some others the writer knows of, had contacts of some metal a very long way removed from the orthodox platinum. They developed sufficient resistance every few weeks to stop the current from the feeble pair of dry cells put in. The only thing to do was to regularly give the contacts a clean up with the point of a pen-knife blade.

Another suburban house bell had a good store of residual magnetism, and its armature regularly "struck work" till a piece of gummed paper was put on to keep it off the magnet ends. Bad connections and loose terminals are ordinary defects on bells, and it will usually be found that the connection between the two magnet bobbins is simply twisted. A touch of solder to the joint will make it more reliable.

Many bells are of poor quality, but the average dry cell is often worse. The writer revived a couple of "dead" and useless cells, and they worked for two more years by simply breaking the pitch sealing at the top and pouring in a few teaspoonfuls of common salt solution. This soaked in, and greatly reduced the internal resistance of the cells. Quite recently another pair of dry cells gave out and failed to produce a tremor at the bell, but the simple expedient of applying Ohm's law, and connecting the two cells in parallel instead of series has brought the bell to life, and it rings even better than ever. Incidentally, the cost of a pair of new batteries was saved at the same time.

Another tip which is worth knowing is that when a pocket-lamp battery is no longer able to energise the lamp, it usually has a lot of life left, and will ring a set of house bells vigorously for weeks. Even when it fails to perform this duty, it is not necessarily down and out—one or two out of three cells will often be found to be quite lively, if separated from the "dud" which has developed a high internal resistance.

Training of Ex-Service Men.—The large building—Sedgwick St. Mill in Preston, is being transformed into a training centre for ex-service men under the Ministry of Labour. Here ex-soldiers will be taught furniture making, electrical engineering, joinery, armature winding, &c. The centre will accommodate 200 men, who will be able to get their meals in the canteens on the premises.

THE ELECTRICAL INDUSTRY OF NORWAY.

There has been prepared by the Commercial Secretary to H.M. Legation at Christiana (Mr. C. L. Paus) a report on the commerce and industry of Norway down to the end of the year 1919. It has been published by H.M. Stationery Office (Cmd. 839. 1s. net).

Norwegian prosperity was, as everybody knows, greatly enhanced during the war, and the industries of the country have undergone important development. The story is told at length in nearly 130 pages, including tabular appendices giving lists of works carried out between 1914 and 1919, and those in progress at December 1st, 1919.

The natural resources of the country are described, its legislation is summarised, labour conditions are reviewed, social questions, including cost of living and social legislation, are discussed, transport facilities are detailed, and a considerable section is devoted to industry and trade.

No doubt many of our readers will desire to study the complete document, but for the benefit of others we may refer to two sections which should interest electrical men.

Electrical Machinery and Fittings.

Mr. Paus, in the section dealing with electrical machinery and fittings says:—

"It is estimated that prior to the war 75 per cent. of the Norwegian trade in electrical material was in German hands. Exports from the United Kingdom were small, practically only one firm of British manufacturers trading in this market. The articles in which they dealt consisted of generators, transformers, and switchgear, principally large machines specially designed to meet Norwegian requirements. The reason why other British manufacturers did not compete is stated to be that the standard British designs of all kinds of small material do not comply with Norwegian regulations.

"The total Norwegian trade in electrical material before the war is estimated by an expert to have amounted to approximately 60 million kroner, of which Germany held 45 million, England 2 million, Sweden 4 million, Switzerland 4 million, and Norway 5 million.

"During the war the Germans succeeded in maintaining their pre-war standard of trade until about the summer of 1916, after which time it fell off considerably, particularly as regards heavy machinery. They were, however, unable to make delivery of cable after early in 1915.

"A considerable change in the situation took place from 1916 onwards, and it is estimated that the average annual value of the trade in electrical material during the years 1916-1919 inclusive has been as follows:—

Norway	25 million kroner.
Sweden	18 million kroner.
Switzerland	2 million kroner.
England	4 million kroner.
Germany	10 million kroner.
America	14 million kroner.

"It will be observed that a very much larger proportion of the trade has fallen to Norway, and that America has appeared in the field as a new competitor. All classes of materials have been delivered from the latter country, while Norwegian production consists mainly of the smaller classes of apparatus. Germany continued to hold the leading position in the lamp market, although some shipments of lamps were received from Holland.

"Deliveries from the United Kingdom were hampered by war conditions, and in spite of the increased value of British exports their value did not increase. It is estimated that the trade in small machines is held 60 per cent. by Germany and 40 per cent. by Norwegian factories.

"The present position in the trade appears to be the following: The Norwegian electrochemical industry is passing through a period of acute depression, and only one large inquiry for electrochemical plant is at present in the market, viz., for delivery to A/S. Bremanger, who are harnessing waterfalls, and will build a zinc factory at Bergen. It is expected that the contract for their plant will be given to an American firm who specialise in this type of machinery. The present demand for electrical machinery comes principally from the Norwegian Government, who require material for railways and their own power schemes, and from county and municipal bodies, who have initiated schemes for providing heat and light for domestic purposes, and power for the use of small industrial concerns. Many such schemes have been launched during the war, and most of them will probably be completed, but few new ones are at present being initiated, owing partly to industrial depression and the fear of financial difficulties, and partly to the adverse state of the American exchange.

"It is believed that British manufacturers cannot at present produce machines for over 50,000 volts (which form a great portion of the Norwegian business), or electric railway plant for which there is sure to be a large future demand in this country. There is already a constant and considerable demand for every kind of electrical fittings and cable, particularly for domestic, heating, and lighting apparatus. All the details for lighting fittings are imported from Germany, while heating apparatus comes almost exclusively from America and Switzerland.

"During the last six to eight months German firms have booked large orders in Norway for all classes of electrical goods, including cables, but Norwegian buyers are at present disinclined to place further contracts in that country, as delivery under existing contracts is subject to great delays.

"British manufacturers who contemplate competition in the Norwegian market must be prepared to secure adequate local representation, to manufacture material which complies with Norwegian regulations, and to keep in the country a staff of expert fitters capable of installing and putting into service the machinery which they deliver."

Electro-Chemical Industry.

In referring to the Norwegian electrochemical industry, Mr. Paus remarks that this industry "would appear to find a peculiarly suitable home in Norway owing to the immense supply of cheap water power which is available." It is, however, very largely dependent on imported raw materials; the zinc refineries require spelter, the carbide factories anthracite or coke, the aluminium factories alumina, and so on, all of which, in addition to electrodes, must be imported from abroad. It was, therefore, natural that these factories should during the war mainly have been engaged upon contracts for the Allied Powers, who were in a position to supply them with the necessary raw materials, and received in return carbide, cyanamide, nitrate of lime, nitrate of ammonia, aluminium, refined zinc, ferro-chrome and ferro-silicon. Exports to the Central Powers consisted of carbide and minor quantities of refined zinc and nitrate of lime.

"As all these commodities were required for war purposes, the Norwegian electrochemical industry experienced throughout the war a period of unprecedented prosperity, which induced some factories to extend their plant and encouraged the establishment of others. The erection of two large plants for the production of carbide and one for production of aluminium was commenced, while the existing aluminium factories under French control extended their operations. The cost of plant imported under war conditions was necessarily very high, and it is probable that the new establishments will have to write down their capital before they can compete in the open market under normal conditions.

"Exports to Germany grew gradually smaller as the war progressed under pressure of the blockade, and by the middle of 1918 consisted only of small quantities of carbide and nitrate of lime, the largest carbide factory working for the Central Powers, the Usines Electrochimiques de Hafslund, which had hitherto been under Austrian control, having then been transferred to Norwegian ownership and ceased to supply the enemy.

"The demand for electrochemical products diminished considerably in 1918 and 1919; the war having ended, the period of prosperity came to an abrupt termination. It was then found that owing to the high cost of coal and labour in this country the Norwegian factories, with the exception of Norsk Hydro Elektrisk Kvælstofaktieselskab, could not compete with the Americans even in the European market. A period of stagnation then set in, punctuated by strikes and other labour troubles. For many months the whole of the industry was at a standstill, and, although the labour questions have now been settled, production is reduced to a minimum except in the case of Norsk Hydro, who, since August, have been working at their full capacity on the manufacture of nitrate of lime and nitric acid. It is stated, however, that even in the case of this firm, which has its water-power practically gratis, costs of production are so high as to leave only a small margin of profit.

"At the end of 1919 the position remains practically unchanged, but a more hopeful feeling than prevailed four or five months ago is now noticeable, and it is felt that costs of production in the various countries all over the world must sooner or later assume the same relation as they held before the war, with the result that Norway will resume her old place in the world market. No coal is, however, produced in Norway, and so long as freights remain excessive it seems impossible that Norwegian industries, which largely employ coal as a raw material, can hope to compete with similar industries in coal-producing countries, even if the cost of labour becomes approximately the same in all countries."

THE HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO.

In presenting the twelfth annual report of the Hydro-electric Power Commission of the Province of Ontario to the Hon. Lionel H. Clarke, Lieut. Governor, Sir Adam Beck, the chairman, emphasises the difficulties experienced during the period under survey caused by the return to peace conditions upon the signing of the armistice in November, 1918. At that time the Commission was supplying approximately 70 per cent. of its total output to 400 plants engaged in the production of war material. The result of the cessation of hostilities was almost complete idleness so far as these factories were concerned, with a corresponding bad effect upon the sales of power. But so quickly was the machinery and plant adapted to peace-time needs that by the following August (1919) the output had reached normal conditions, and, gradually improving, by the end of the year the whole available power generated was being taken. At the beginning of the year covered by the report a schedule of rates to cover the cost of service to all municipalities was fixed, which brought in a revenue of $3,729,706, but the aggregate operating costs amounted to $3,860,701, and the net result was, therefore, an excess of expenditure over income of $130,995.

In spite of the many difficulties encountered owing to delay in the delivery of plant and materials, development work has steadily progressed, obsolete plant has been replaced, new stations have been erected, and new plant installed. On the system of the Ontario Power Co. at Niagara Falls, taken over by the Commission in 1917, a 15,000-K.V.A. generator, delivered in 1918, was erected on temporary foundations, and put into service as a synchronous condenser, in which capacity it acted up to July, 1919, supplying about 12,000 reactive K.V.A. to a 12,000-volt bus. This machine was dismantled and re-erected in its permanent position in 28 days.

What will be the two largest water-wheel generators in the world are on order for the Queenston generating station. These are being manufactured by the Canadian Westinghouse Co., Ltd., and are designed for an output of 45,000 K.V.A. at .8 power factor, 3-phase, 25 cycles, 12,000 volts, at 187.5 R.P.M. The generator frame will be 25 ft. in diameter, and the whole machine, with a 175-KW., 250-volt exciter and thrust bearing, will weigh approximately 1,380,000 lb. Specifications are being prepared for two further generators of the same rating as well as thirteen 15,000-K.V.A., 12,000—63,500-volt single-phase transformers. The Canadian General Electric Co. is constructing a large capacity synchronous condenser for the Niagara system. This machine is rated at 10,000 K.V.A., three-phase, 25 cycles at 13,200 volts, and 315 R.P.M. It is to be fitted with an 80-KW., 125-volt exciter, an auto-transformer, and a motor-driven high-pressure oil pump. The four lines from Niagara to Dundas were fitted with 110,000-volt oil circuit breakers during the year, and metering equipment for the 110,000-volt load was put into service in September, 1919. The designs for the construction of the Nipigon generating station in the Thunder Bay system are well under way. The first step taken was the erection of a temporary 250-K.V.A. station for the provision of light and power for the construction of the main works. The Nipigon station will eventually house six 10,600-K.V.A. vertical water-wheel-driven generators, and three 24,000-K.V.A. transformer banks, each consisting of three 8,000-K.V.A. units. Three fully equipped 110,000-volt lines are to be taken from this station, as well as a number of 12,000-volt feeders. The first part of the installation will consist of two generating units, one bank of transformers, and one outgoing line. In the Rideau system, work has been commenced on the High Falls generating station; the equipment of this station is to consist of four 3-phase, 60-cycle, 350-K.V.A., and one 875-K.V.A. horizontal shaft generators. The 350-K.V.A. machines will be driven by two turbines, one generator direct connected to each end of the turbine shaft. The 875-K.V.A. generator will be direct connected to a separate turbine. Three 750-K.V.A. step-up transformers are also to be installed.

Extensive power and storage surveys have been carried out on all parts of the Commission's systems, particularly on the Trent, Severn, and St. Lawrence rivers.

Excavation and construction work has been proceeded with at Niagara, where two new 20,000-H.P. turbines have been installed. This new plant necessitated the excavation of 147,000 cubic yards of material and the placing of a wood stave pipe 13.5 ft. in diameter and 6,600 ft. in length. The water-wheels run at a speed of 187.5 R.P.M., and develop 20,000 H.P. under a head of 180 ft. Construction on the new development from Chippawa to Queenston has proceeded rapidly. Some idea of the magnitude of this work may be obtained from the fact that the largest electric shovels ever built are in operation, and that 50 miles of standard-gauge railroads have been laid in connection with the work. The river section is being deepened and widened by means of dredges and a cableway, and 492,000 cubic yards of material had been removed up to the time the report was made. The forebay which has involved a great deal of rock drilling is assuming shape, 437,000 cubic yards of rock having been taken out. On the canal proper 3,675,000 cubic yards of earth and 283,000 cubic yards of rock have been excavated, and the walls and canal linings have been treated with concrete. The two 50,000-H.P. turbines are being built by the Wellman-Seaver-Morgan Co., and delivery is expected early next year. The Nipigon development at Cameron Falls is supplied by a drainage area of 9,100 square miles. A dam consisting of a gravity section with about five sluices is to be constructed. The headworks will be of reinforced concrete, from which concrete pipes will carry water to 12,500-H.P. turbines operating under a 72-ft. head at 120 R.P.M. These turbines are to be set in reinforced concrete scroll cases. The tail race of the Healey Falls development was excavated to the extent of 48,000 cubic yards to permit the installation of a new 12-ft. diameter steel penstock to supply an additional 5,600-H.P. turbine direct connected to a 3,750-K.V.A. generator.

The total mileage of lines built and acquired by the Commission was, up to October 31st, 1919, 2,584. This total includes 467 miles of 110,000-volt steel-tower line in the Niagara system, and 964 miles of lines erected on wooden poles. In the Central Ontario system the total length of lines is 369 miles. The greater part of these transmission lines are of aluminium, and the rest are of steel reinforced aluminium, copper, copper-clad steel, galvanised iron and galvanised steel. In the report the various types of wires and cables employed are tabulated, telephone lines being included with transmission lines. The comparative weights of material used are interesting. The weight in pounds of materials used up to the end of October, 1919, are as follows: Aluminium, 2,864,381; copper wire, 2,467,351; galvanised steel cable, 1,296,669; galvanised iron wire, 777,242; steel reinforced aluminium, 498,928, and copper-clad steel, 230,466. The total number of steel towers erected to October 31st, 1919, was 446, and wooden poles numbered 76,656.

Electric railway work, which was curtailed to a minimum during the war by a special Act of the Legislature, was resumed during the period surveyed in the report. Although little constructional work has been carried out, plans have been prepared, and municipalities have been ascertaining the desires of their citizens regarding new lines. In many cases the proposed lines are identical in parts to the Grand Trunk Railroad, and the Dominion Government, which practically owns this system, is being urged to secure for the municipalities the right to run cars on such portions of the line as run through their districts. This will effect a tremendous economy, and many townships will be concerned.

The position of the Commission's laboratories has become one of increased importance, and quite 50 per cent. of the work done in them may be designated as research. Among the many investigations carried out by this department during the year may be included the following: Analysis of the conditions to be met by high-tension insulators and corresponding tests, relative merits of different types of line construction from 12,000 to 44,000 volts; factors affecting the interference of power lines with communication lines, due to electrostatic and electromagnetic induction, and the effect of various modifications in present apparatus for protection against lightning. A great deal of test work has been done on new plant. The Meter and Standards Laboratory has executed a large number of tests, but the work on the whole has been of a constructive nature. The Photographic Laboratory had an increased volume of orders to attend to from the engineering staff. The Chemical Laboratory conducted tests on oils and greases, paints, varnishes, and analysis of a wide range of materials from rubber to coke and steel. A 100,000-pound capacity motor-driven, and a 20,000-pound hand-driven Olsen screw testing machines have been added to the equipment of the Structural Materials Laboratory for the carrying out of tension, compression, and bending tests. Four thousand tests have been made on concrete mixtures to determine the correct proportion of mixtures to give desired results.

In concluding his letter presenting the report, Sir Adam Beck acknowledges the untiring zeal and faithful attention to duty of the staff of the Commission, and says:—

"The Commission submits its report with a feeling of satisfaction, knowing full well that its activities have been subjected to an inquiry of the most searching nature, the result of which is a vindication of the policy of public ownership and operation of electrical utilities, and of the Commission's methods of management and operation," the truth of which statement is borne out by this last record of the Commission's work.

Why the Blue-Print?—Under this title a contributor to the *American Machinist* comments on the inconvenience, owing to size and occasionally to faulty reproduction, of the blue print, and suggests an alternative method of supplying working details to shops. By the employment of photo-engraving upon zinc, details can be clearly shown in a considerably smaller space, and it is quite possible to reproduce many drawings measuring 30 in. × 20 in. upon a block the size of a postcard. This, of course, is constantly being demonstrated in reproductions of detail drawings in technical journals. The writer suggests that any manufacturer interested in the proposal might select one drawing or tracing for this purpose and thereby ascertain what points need accentuating to make the system a practicable one from the mechanic's point of view. The cost of the process is very economical if a large number of reproductions is required, but in cases where one or two prints only are wanted, it would not be a paying proposition.

THE CRYSTAL PALACE EXHIBITION.

Although it requires a stretch of imagination to appreciate the fact, an exhibition of engineering products is actually in being at the Crystal Palace, Sydenham, S.E., as a sort of supplement to the Imperial War Museum and Great Victory Exhibition that is now being held there. Contrary to what one would be led to expect from the grandiose title given it, the Exhibition is a very poor show (not on account of the quality of exhibits, but in point of numbers), and must, we fear, prove disappointing to the few firms who have taken the opportunity of exhibiting. Conspicuous by his absence is the business visitor, and the show, from a business point of view, must support the opponents of a serious exhibition as part of a general fair.

Apart from the War Museum in the main hall and the pleasure ground, the Exhibition is divided into four sections: Engineering, oil, gas, and electrical, and, be it noted, the last section is the poorest of the lot. These four small sections, the business aspect of which recedes far into the background, sprawl for the most part under the main floor, and may easily be overlooked by the average visitor.

The engineering section, which is general in character, nevertheless contains much that will interest electrical engineers. The section comprises 29 stands, ten of which, however, are occupied by one firm and its associated undertakings, and is in reality one large stand. The three most prominent stands are those of the Vickers, Beardmore, and Armstrong Whitworth combinations.

The oil section is housed in a separate building removed from the rest, and is made up of ten stands, on which are seen some good examples of oil engines in motion, pumps, boiler oil-furnace systems, and samples and the products of various oil companies.

In the gas section, which contains 13 stands, some of which were unoccupied at the time of our visit, one sees gas engines, cookers, irons, stoves and radiators, water heaters, lighting fittings, &c.

The electrical portion, which, as stated above, is a poor show, excites little attention. The only apparatus of any size exhibited on the 17 stands in the section is that shown by Messrs. Wm. Geipel & Co., which includes switchgear, motor starters, and speed regulators. A feature is the contactor type of panel for automatically controlling D.C. motors which has recently been placed on the market. It consists of a single-pole contactor main switch which operates in the main circuit between magnetic blow-outs and a master rheostat. The latter is of novel construction, comprising a series of contact fingers corresponding to the number of rheostat contactors. When the master controller is in the "off" position the contactor-operating coils, which are arranged in series in a common circuit, are short circuited. They are brought into operation one after the other by the operation of the master solenoid, until the whole of the resistance is cut out. The exhibit includes dimming and automatic time switches, wires and cable, resistance units, and instruments for measuring, testing, and electro-medical purposes. A portable kinematograph projector that was recently described in our pages is shown by the Oxford Educational Films Supplies Co., Ltd., while the Vulco Magneto Co. has on view accumulators, dry batteries, and ignition coils.

The British Ebonite Co., Ltd., Messrs. Ebonestos Insulators, Ltd., and Messrs. Attwater & Sons each have a show case containing samples of their well-known insulators and insulating materials. Messrs. F. L. Mitchell & Co., Ltd., exhibit wireless telegraphic and telephonic apparatus, medical coils, instruments, and electrical novelties, the main exhibit being the "world wide" wireless receiving set which covers all wave lengths of from 150 to 25,000. By a special process of winding the inductors, capacity effects are minimised. Fine adjustment is rendered possible by the combination of selector switches; two valves are used for high-frequency amplification and two for low-frequency, a separate H.T. battery being employed for each pair of valves. The cabinet containing the outfit is but 3 ft. square, and the makers claim that it will receive messages from any average-power station in the world. A new type of 3-valve amplifier is also shown by means of which an almost unlimited variety of circuits can be arranged by connecting or disconnecting to the terminals, mounted on the amplifier, which intercommunicate with plate and grid connections inside the instrument.

Messrs. A. Winston & Co., Ltd., exhibit X-ray apparatus, while the Synchronome Co., Ltd., provides the time-keeping service throughout the electrical and engineering sections of the Exhibition, the various clocks being operated from one self-wound controlling pendulum exhibited in the electrical section. The London Electric Wire Co. & Smiths, Ltd., shows a selection of wires and cables, while amongst the exhibits of Messrs. A. Gallenkamp & Co., Ltd., in the engineering section are seen electric furnaces for the Lessing coking test of coal, and electric laboratory furnaces.

Domestic electrical appliances form the majority of exhibits in the electrical section; suction sweepers are shown by the Hoover Suction Sweeper Co., Ltd., and Messrs. Magic Appliances, Ltd., and Messrs. Charles Beck & Co., Ltd.; the latter firm also has on view electric washing machines and ironers, which are only partly electrical inasmuch as they are heated by gas or petrol.

So far as concerns the War Museum, which is intended to be a national record of those things which helped in the painful spelling of the word "Victory," it will suffice, without going into a detailed description, to record that relics from captured and surrendered German submarines, including electrical cooking and heating apparatus, motors, accumulators, switchgear, instruments, &c., are in the collection. There are also types of British searchlights, German landing lights for aircraft, cable wagons, cables, air line stores, telephones, Fullerphones, wire and wireless telegraphic apparatus, and many other exhibits of interest.

STREET LIGHTING WITH LOW MOUNTED UNITS.*

The Kensico reservoir, located east of the Hudson River, about 30 miles approximately north from the New York City Hall, is an artificial lake formed by the Kensico dam across the valley of the Bronx river about three miles north of White plains, near the village of Valhalla, N.Y.

The arts of structural and landscape architecture have been employed to make the entire construction a work of beauty, in keeping with its magnificent proportions.

A public highway, carrying considerable automobile traffic, traverses the top of the dam. The part of the roadway crossing the top is approximately 2,200 ft. long and 26 ft. wide. It is bordered on one side by a sidewalk about 4 ft. wide. The roadway is brick paved and runs between cut stone parapets approximately 4 ft. in height.

The architectural specifications for the dam would not permit the use of poles in connection with a lighting system of the roadway. It was, therefore, decided that the lighting

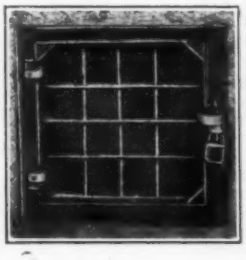


Fig. 1.—Exterior of Lighting Unit.

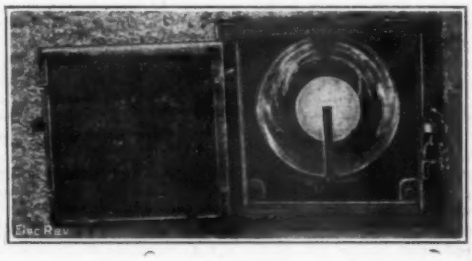


Fig. 2.—Interior View, showing Prismatic Glass Door, Reflector, and Baffle in Position.

should be provided from ports located in the side of the parapet wall. Openings were cut in the stone work approximately 13¼ in. square and 15 in. deep, spaced approximately 37½ ft. apart and located on both sides of the roadway with a staggered arrangement of spacing. The centres of the openings are 26½ in. above the surface of the roadway.

The complete lighting units are neat in appearance and of weather-proof construction. Each unit comprises a reflecting device with baffle and mounting, a dispersing door and a transformer. The mirror is approximately 11¼ in. in vertical diameter and 10¾ in. in horizontal diameter, and the shape is that obtained when a series of conical frusta, each ⅜ in. in width, is cut by a plane parallel to the axis and ¼ in. distant, the smaller portion being used, and two such joined together. The sections of conical frusta above mentioned are such as would be tangent at their middle points to an inscribed parabola of 2¼ in. focal length. There is a curved baffle located directly in front of the lamp so as to screen direct rays from the lamp filament.

A cast metal frame of suitable size fits the opening in the parapet wall, and carries a hinged door which is fitted for supporting the prismatic glass. The dispersing glass in the door consists of one piece of sheet prism glass with the prisms placed vertically, and its function is to give some diffusion and give additional spread to the beam of light so as to produce uniform illuminaton over the surface of the street.

The source of light consists of a 6-volt 108-watt Mazda "C" headlight lamp. As these lamps operate at a very high efficiency and are designed for shorter life than is considered practicable for street-lighting service, it was deemed desirable to operate them at a somewhat lower efficiency than rated.

*Transactions of the Illuminating Engineering Society, April 30th, 1920. Abstract.

Consequently, power is supplied by means of individual transformers giving 5½ volts. Operating at this voltage, the lamps will consume approximately 94 watts and give an average life commensurate with that of lamps designed for street-lighting service. Figs. 1, 2, 3 show in detail the location and construction of the lighting units. In addition to the ones used on the roadway, similar lighting units supply illumination for the terrace along the base of the dam.

There is a very wide spread of light in the horizontal plane and consequently the illumination over the whole roadway

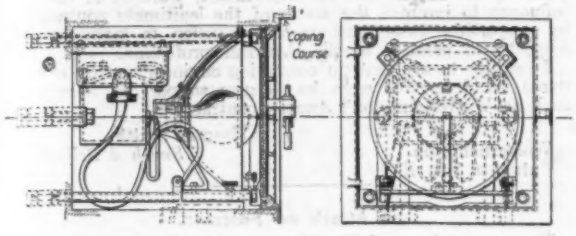


Fig. 3.—Section and Plan of Lighting Unit.

and parapet walls is comparatively uniform. The illumination falls off rapidly above the horizontal, and at the eye level of an automobile driver the intensity is comparatively low. Critical observations of the lighting effect show it to be adequate to meet the usual requirements of first-class highway lighting and agreeable to travellers. The night views, figs. 5 and 6, show the illumination results obtained, the former being taken looking along the level of the roadway while the latter was taken at a considerable elevation. A system such as that described may or may not be practical for the lighting of ordinary streets or roadways, depending upon conditions and requirements. However, the results obtained in this particular case are gratifying and may form a basis for other installations of similar requirements. The power consumption is not prohibitive (approximately 5 watts per running foot of roadway), the

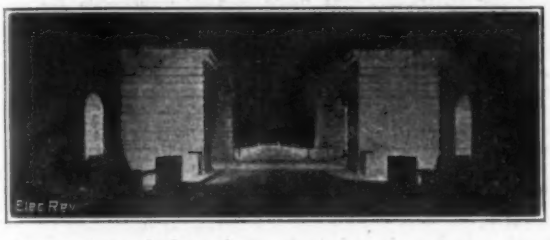


Fig. 4.—Night Photograph, Looking along Level of Roadway.

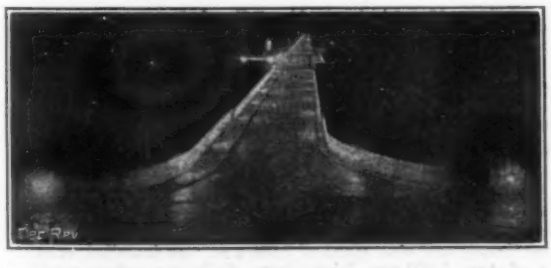


Fig. 5.—Night Photograph, Looking Down upon Roadway.

illumination is of sufficient uniformity, there are no poles to mar the architectural beauty of the structure, light is confined and distributed so as not to be objectionable from the standpoint of glare—all of which are factors that have considerable bearing in striving for the ideal of the illuminating engineer.

The idea of using low mounted units for street lighting is not new, but grave doubts had been expressed concerning its practicability. This successful application demonstrates its possibilities.

Proposed Solent Tunnel.—Sir Eric Geddes, Minister of Transport, on July 28th, received a deputation from the Isle of Wight, which pressed for improved means of communication between the island and the mainland. It considered that the best solution of the difficulty was to construct a tunnel under the Solent. In reply, Sir Eric Geddes said that at present the cost of constructing a tunnel under the Solent would be more than £2,000,000, and he was doubtful if the revenue would be sufficient to make the tunnel self-supporting.

ELECTRICITY SUPPLY AUTHORITIES.

We have received from the Secretary of the Association of Municipal Corporations a report of the proceedings on July 13th, when a deputation from the Association attended at the Ministry of Transport with regard to the Electricity (Supply) Bill. Sir Robt. Fox, Town Clerk of Leeds, and chairman of the Law Committee of the Association, said the Association held that there was no need to proceed with the whole Bill; they had better be given an opportunity of seeing how they could work the 1919 Act, but that Act made no financial provision. In the opinion of the Association, the main requirement of the moment was the enactment of the clauses of the 1919 Bill, which dealt with finance, providing a sum of 25 millions for the Electricity Commissioners to lend to the joint electricity authorities. Municipal authorities were experiencing very great difficulty in raising money, and in order to get the national electricity supply scheme on its feet, they must have from the Exchequer either money or a guarantee. They objected to the rates being employed as security—they could not afford it; they looked to the taxes for a guarantee. Incidentally, Sir Robert raised the question of small isolated undertakings such as those at Folkestone or Harrogate, which required electricity supply, but were remote from industries; could they not be left alone to carry on as before?

In reply, Mr. Arthur Neal, M.P. (Parliamentary Secretary to the Ministry of Transport), said the Act did not insist on the inclusion of all undertakings in the national scheme; it was permissive only. He was well aware of the position outlined by Sir Robt. Fox. The Commissioners had reported to him that they had no reason to be dissatisfied with the signs with reference to the formation of joint electricity authorities, and if those authorities came into existence throughout the areas delimited, the question of district boards would disappear. It was not proposed to proceed with the present Bill until the autumn; it might be thought unnecessary to proceed with it in its present form. With regard to raising money, he could not agree that it could be done only in two ways—on the security either of the rates or the taxes. Public companies which had no rates to fall back upon were under statutory obligation to find money. The joint electricity authority would always have the security of the undertaking itself. He agreed that it was easier to raise the money with the backing of the rates or taxes, and it might be cheaper, but that was only a question of terms. The main attack in the House of Lords was on the financial clauses. Government guarantees were extremely difficult to get from the Chancellor of the Exchequer. In many cases it would be for the corporations whose undertakings were being pooled to guarantee the capital in respect of the joint authority. That would not involve a charge on the rates, unless the undertaking became financially unsound. The Commissioners were very anxious that Corporations helping to frame the schemes should back them with the rates.

Sir Robt. Fox again "implored" Mr. Neal not to ask them to charge the rates, and urged that where there was some Government assistance, it would tide the joint electricity authority over the first short and difficult period during which money had to be spent before there was any revenue. There was no difficulty when the revenue began to come in, and there was no chance of a charge on the rates.

THE RECOVERY OF ALCOHOL FROM COKE-OVEN GAS.

At a meeting of the Cleveland Institution of Engineers in December last, a paper by Messrs. Ernest Bury and O. Ollander on "By-product Development in the Iron and Steel Industry" was read by Mr. Bury. Particulars of the plant for the electrostatic deposition of flue dust at the Skinningrove Ironworks were to have been given, but the plant had not been completed; it is intended for the recovery of potash. We have now received from Mr. Bury a printed copy of the paper, of which the following is an abstract.

The national requirements of motor spirits for all purposes are 160 million gallons per annum, towards which only 30 millions are home-produced. In 1912 Mr. Bury suggested that ethylene could be recovered from coke-oven gas, which contains 2 per cent. by volume of ethylene and its homologues. By the fixation of ethylene 23.4 million gallons of alcohol could be recovered from the by-product coke ovens of the country, as well as 27 million gallons from the gas works; with 30 million gallons of benzol from the former and 34 millions from the latter in addition, a total of 114.4 million gallons could be home produced, out of a total of 160 millions.

Research was undertaken during the war for the production of ethylene, and after the armistice attention was turned to alcohol. Strong sulphuric acid was used as the absorbent, in preference to charcoal, and it was found that 70 to 80 per cent. of the total ethylene present in the gas could be absorbed, at a temperature of 60 to 80 deg. C. From the resulting ethyl hydrogen sulphate, an 80 per cent. yield of acetic acid could be obtained by electrolysis; a 70 per cent. yield of ethyl alcohol could be obtained by hydrolysis with superheated steam. The process involved the formation of sulphur dioxide in the acid, but on passing the SO_2 waste through the coke-oven gas it reacted with the H_2S in the gas, both

purifying the gas and providing sulphur for the manufacture of sulphuric acid, to be used for alcohol recovery and for the manufacture of sulphate of ammonia.

The heat required to raise the temperature of the cooled gas to 80 deg. C. was obtained from the wet gases evolved from the coke-oven plant at 250-300 deg. C., and that required to heat the absorbent acid was derived from producer gas made from waste coke-dust briquettes. The ethylene extracted from the gas represented only 4.7 per cent. of the total calorific value of the dried gas, and only 1.1 per cent. of that of the moist coke-oven gas, hence the heating value of the gas was not appreciably lowered.

The authors explained the arrangement of the recovery plant and its operation, and claimed as new the use of a temperature of 60 to 80 deg. C. for the absorption process, the utilisation of waste heat and fuel for the purpose of the reactions, and the utilisation of the decomposition product (SO_2). They were satisfied that they could make cheap alcohol from coal gas on an industrial scale.

In the discussion, Dr. Stead said the paper marked an epoch, and was noteworthy for the discovery of the best temperature to employ and the utilisation of waste heat. Other speakers paid tribute to the pioneering work done at Skinningrove; Mr. Alfred Hutchinson, the head of the firm, stated that Mr. Bury was one of the first in England to recover benzol from coke-oven gas. The result of his patient work was such a yield of alcohol as, mixed with benzol, would produce the most perfect motor fuel yet devised, and almost double the national resources in this respect. In the process he not only recovered ethylene, the source of numerous valuable substances, but also used the by-product SO_2 to recover sulphur from the H_2S in the gas, used part of the sensible heat in the gas, and finally used the only remaining waste material—the fine coke dust for which no one had previously found any use. By thus producing alcohol from coke-oven gas he saved the food-stuffs hitherto consumed for that purpose. Mr. Hutchinson pointed out that the authors' work emphasised the value of an adequate, highly-trained staff, capable of undertaking organic as well as inorganic research, in modern steel works.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Maximum Load Indicator.

In your issue of July 23rd an inquiry is made for a device for checking the maximum load on transformers.

We believe the Reason Co., of Brighton, has made a special form of its maximum demand indicator for fitting on transformers and in feeder pillars.

For checking the loading of transformers by the maximum temperature reached it has been found useful and practicable to employ maximum and minimum thermometers.

It is necessary, of course, to have one in or closely adjacent to the transformer and another exposed to the outside air.

E. D. A.

London, W.C. 2.
August 6th, 1920.

Municipal Contracting.

I shall be glad if you will allow me to correct a statement which appears in the description of the extensions to the Wolverhampton Corporation Electricity Works in your issue of July 30th.

Therein it is stated that the electricity department's relations with the contractors of the town are very satisfactory, and with the view presumably of giving proof of the healthy condition of affairs, it is added that sixteen new contractors have sprung up within the past few years.

Lest your statement be accepted by your readers, and used by supporters of municipal trading as evidence of the beneficent influence of this particular form of communism, or perchance lead to a further influx of budding contractors in search of an El Dorado, it is but fair to state that the leading contractors of the town are far from being satisfied with the methods adopted by the electricity department, and look with dismay on the degradation of the industry which is in progress.

As evidence of this, a deputation of the four leading contractors called on the engineer and chairman of the Electricity Committee to ventilate their grievance, and to ask for a modification of the treatment they were receiving at the hands of the department. I am sorry to say that the interview did not bring about any improvement.

Unfortunately the attitude of the department has materially changed during the past few years, and it appears that an endeavour is being made to hasten the demise of the contractor by an overdose of kindness.

It is very obvious that a system which enables a powerful public department to handle tenders, and "pass on" what it thinks fit while charging a commission on the process of "passing," can be operated very much to the detriment of those who accept the passes.

I agree that on the face of it this rapid sprouting is an indication of the fertility of the soil, and perhaps more so of the efficacy of the artificial manure supplied by the electricity department to stimulate their growth, but the best result will not be attained unless the process is accompanied by suitable selection.

Mr. Allen could give very material assistance to the contracting industry, while at the same time enhancing the publicity of himself and his department, were he to use his influence to improve the status of the legitimate contractor, by supporting those who are in a position to maintain the respect and prestige of the electrical profession.

I venture to say that no consulting engineer worthy of the name could survive were he to give support to a retinue such as Wolverhampton's twenty contractors.

Thomas Smith.
Smith & Bellhouse.

Wolverhampton.
August 7th, 1920.

An Attack on Foremen.

The current issue of *The Electron*, the official organ of the E.T.U. contains an extract from the "Business Man's Magazine," 1908, entitled "But Still True." It is a virulent attack on the personal characters of foremen generally. The anonymity of the original contribution is to be deprecated; but, at the same time, it should be refuted—it is too general. No sane man would write such a deliberate perversion of the truth, unless afflicted with a bad attack of *cacoethes scribendi*. What was the editor doing to publish such stuff on the front page of a journal which has (or at least should have) as its object to tell the truth to its readers?

As the contributor has made himself responsible for one particular paragraph by transforming the common letterpress into italics, that paragraph is given here: ". . . Whenever I find a workman employed uninterruptedly for a great number of years in a large works where other men are being frequently suspended or discharged, I am suspicious of that man's integrity or ability." In my opinion, and I have been a foreman of engineers for nearly forty years, the statement is as false as hell, and should be refuted by all mechanics—honest and able, and who have been able, as a direct result of their integrity and ability, to hold their positions, while others less honest, and less able, have continued to compose the flotsam and jetsam of the casual labour crowd, who are bound to be discharged first when trade slackens.

I have not the slightest antipathy towards the E.T.U. nor its official organ, but as a foreman who has always been a particular friend and helper to men who have served under me, I strongly resent the attack on myself, and on many splendid men of my own personal acquaintance, by the writer to *The Electron*.

A London Foreman.

August 2nd, 1920.

THE INSTITUTION OF MECHANICAL ENGINEERS.

At the Lincoln meeting of the Institution, last month, a number of papers were read on subjects more or less directly allied to electrical engineering, which are briefly abstracted below.

Marshalls' New Power Station.

Mr. F. J. Cribb described the new power station of Messrs. Marshall, Sons & Co., Gainsborough. The old station in 1916 was overloaded 100 per cent. A site was purchased on the river Trent, and new plant of 3,000 kw. was installed, consisting of two 1,500-kw. Ljungstrom turbo-generators working at 6,600 volts, 50 cycles, 3-phase, at 3,000 r.p.m., with Reyrolle ironclad switchgear, and four Babcock & Wilcox boilers. A Caird & Rayner evaporator provides pure make-up feed water.

During the six months starting November 1st, 1919, about 1¼ million kw.-hours were generated, with a fuel consumption of 2.85 lb. per kw.-hour (inferior coal). The old station in 1913 generated three million units, at 5½ lb. per unit. Tested in March, the steam consumption of the turbines was 12.42 lb. per kw.-hour. Power is transmitted half a mile to the Britannia Works, and converted to d.c. at 220 volts by motor converters.

The Uniflow Steam Engine.

In a paper on this subject, Mr. F. B. Perry stated that the Uniflow engine was invented in this country in 1885 by T. J. Todd, but did not come into vogue until the idea was developed in Germany; its manufacture was then taken up by Continental and British firms, and as much as 6,000 h.p. has been obtained from a single cylinder at 120 r.p.m. With a boiler pressure of 180 lb. and 200 deg. F. superheat, consumptions of 10.5 lb. and 10 lb. per i.h.p.-hour have been recorded with engines of 500 and 1,500 i.h.p. respectively,

the high economy being due mainly to the reduction of cylinder condensation resulting from the design, which enables a very high ratio of expansion to be secured. The space occupied is also small, and the economy is maintained at low loads. As the whole of the power is developed in one cylinder, the governing is extremely quick in action, and the simplicity of the engine reduces the cost of upkeep, oil, and stores. The author described two engines, built by Messrs. Robey & Co., Ltd., and by Messrs. Galloways, Ltd., respectively.

Some Lincolnshire Oil Engines.

This was the title of a paper by Mr. F. H. Livens, in which he traced the history of the oil engine using heavy oil, culminating in the invention by Akroyd Stuart of the separate vaporising chamber in 1890, which was the origin of the "Hornsby-Akroyd" type of oil engine. These engines in their latest development (Ruston & Hornsby) are made up to 170 h.p. in a single cylinder, attaining a consumption of 0.4 lb. of fuel oil of 18,000 B.Th.U. per lb., equivalent to a thermal efficiency of 30 to 35 per cent. This engine is as economical as the Diesel, without requiring an air-compressor for injecting the fuel or being liable to excessive explosion pressures. The two-stroke hot-bulb engine is also briefly described.

CIRCULATING-CURRENT CONNECTIONS FOR DELTA-STAR TRANSFORMERS.

By J. HENDERSON.

A great deal of confusion has resulted from the non-uniformity of connections of three-phase power transformers. This chiefly results when the transformers are protected by circulating-current gear, and when it becomes necessary to parallel two transformers supplied by different makers.

When three single-phase transformers are connected up delta-star, it is usual to make the delta in such a way that the star currents are 30° leading or lagging on the corresponding delta currents, assuming unity power factor. When, however, three-phase transformers are supplied as single units, it is found in cases that the star currents are 150° leading or lagging on the corresponding delta currents. It is, therefore, possible to have on one system four different types of connection, and as each type gives a different method of connecting up the protective gear, it means that unless some method can be found of laying down a standard system of connections, these must be made by trial and error.

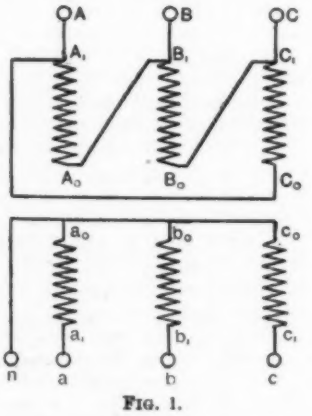


Fig. 1.

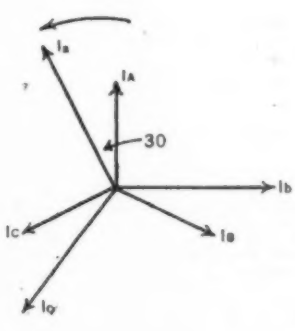


Fig. 2.

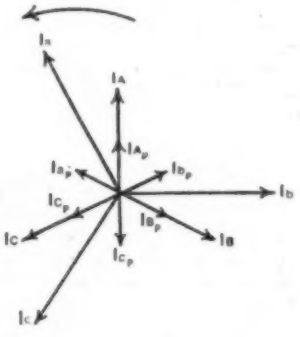


Fig. 3.

The first question to be settled in all cases should be the transformer polarity. This ought to be indicated on the transformer case, and the ends of all windings should be brought out to the top of the transformer, and marked according to the rule laid down by the British Engineering Standards Association. This is reproduced as follows:—

"The two ends of every winding shall be marked with the letters 0 and 1, the end marked 1 being positive. The direction of the E.M.F. from T_0 to T_1 in the primary shall be the same as from t_0 to t_1 in the secondary. The same rule shall apply to the different phases A, B, C, &c., of a polyphase transformer."

Fig. 1 shows a sketch of a three-phase delta-star transformer connected to give normal polarity with the windings marked in accordance with the above rule. The delta connections may be indicated by simply writing down the ends of the windings connected together, thus:—

$$\begin{array}{ccc} A_1\ C_0 & B_1\ A_0 & C_1\ B_0 \\ | & | & | \\ \text{Phase A} & B & C \end{array}$$

A reversal of the delta is got by connecting as follows:—

$$\begin{array}{ccc} A_1\ B_0 & B_1\ C_0 & C_1\ A_0 \\ | & | & | \\ \text{Phase A} & B & C \end{array}$$

The normal star polarity is as shown, a_0 b_0 c_0 being starred and the ends a_1 b_1 c_1 being brought to the terminals.

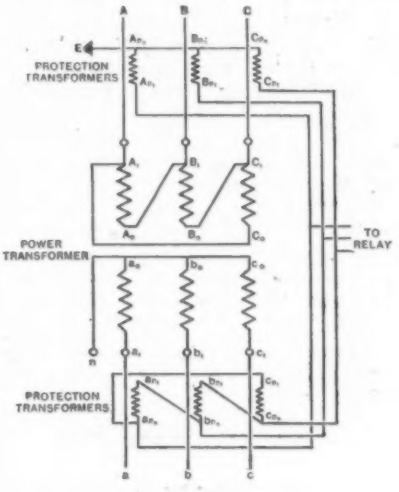


Fig. 4.

If a_1 b_1 c_1 were starred, this would lead to a reversal of th star polarity.

The four methods of connection are tabulated below, and in each case the phase difference between the corresponding delta and star currents is given:—

1. Normal Delta and Star.—Star current leads delta current by 30°.

2. Reverse Delta, Normal Star.—Star current lags 30° behind delta current.

3. Normal Delta, Reverse Star.—Star current lags 150° behind delta current.

4. Reverse Delta, Reverse Star.—Star current leads 150° on delta current.

Fig. 2 shows the primary and secondary current vectors for a transformer with normal polarity as in fig. 1.

The correct connections for the circulating-current protective gear can be obtained at once from the vector diagram, fig. 3.

The protective transformers on the primary side of the power transformer are star-connected, fig. 4. Assuming that the polarities are known and marked, as in fig. 4, A_{p_1} A_{p_0}, B_{p_1} B_{p_0}, C_{p_1} C_{p_0}, it is the general practice to star the

0's and bring out the 1's. Thus the current in the pilot wires leaving the primary protective transformers will be in phase with the corresponding current in the primary cables. This is shown in fig. 3 by the vectors I_{Ap}, I_{Bp}, I_{Cp}. In order to get the current circulating in the pilot wires, it is necessary to have the current in the leads, leaving the secondary delta connected protective transformers 180° out of phase with the corresponding current from the primary transformers. To obtain this, the delta of the protective transformers must be reversed. This causes the current in the pilots to lead 30° on the corresponding current in the secondary cables. This is shown in fig. 3 by the vectors I_{ap}, I_{bp}, I_{cp}, leading 30° on the vectors I_a, I_b, I_c. There is now 60° difference in the corresponding currents in the pilots, and we must have 180°. This can only be obtained by crossing over the pilot wires, as shown by the vectors, or what amounts to the same thing, by connecting the leads A_p, B_p, C_p on to the terminals ap_o, bp_o, cp_o. This is done in fig. 4.

Using the same argument, the connections can be drawn out for any power transformer protected by circulating-current gear provided the polarity is known. If it is not known, a simple test with a small cell and polarised voltmeter will soon give the necessary information.

It cannot be urged too strongly, however, that the makers should all conform to one standard or, failing this, that they should bring out the ends of all windings and mark the phase letters with 0 or 1 to indicate the polarity. This would have the advantage that supply undertakings could in a few minutes change over the connections to suit requirements.

THE RESPONSIBILITY OF ROADWAY AUTHORITIES.

In early days the highways were in charge of the inhabitants of the parishes, and they were responsible for their repair. During the nineteenth century they were gradually taken over by more responsible bodies under different Acts of Parliament. According to the old common law the surveyors of highways could not be sued for personal injuries resulting from the non-repair of highways, or according to the legal terms they could be sued for misfeasance, but not non-feasance. That is to say a highway authority could not be sued for the result of an accident due to a rut, but could if it was due to an obstruction such as a heap of stones left in the roadway. The dividing line between misfeasance and nonfeasance has always been very fine.

Although local bodies are not liable for injuries due to the non-repair of a highway, there are circumstances where, as highway authorities, they are liable, because they are acting in another capacity which does not carry with it the same immunity from the result of some negligent omission. For example, when an accident takes place from a faulty gully grating, the local authority may be liable as the owner of the sewers; and similarly where a water-meter box had a faulty cover, liability was held in the capacity of an authority for watering a street.

When the Tramways Act was passed in 1870 the promoters of the tramways were, by Sec. 28, held answerable for the repair of the roadway between the rails and 18 in. outside the outer rails. By Sec. 55 "the promoters or lessees shall be answerable for all accidents, damages, or injuries happening through their act or default of any person in their employment by reason or in consequence of any of their works or carriages." In accordance with Sec. 29 of the same Act, in order to enable the same authority to be responsible for the whole roadway it was enacted that the road authority could enter into an agreement to keep the tramway strip of roadway in repair, and the liability would then be transferred to the latter. In the case of Howett *v.* Nottingham Tramways in 1883, it was decided by the Court of Appeal that in such circumstances the road authorities could then be sued in case of injuries due to the non-repair, despite the old principle of nonfeasance.

A case was recently tried before Mr. Justice Darling, that of Wrench & Son *v.* Sobey and the London County Council, which illustrates the law on the question. Servants of Mr. Sobey were wheeling a hand-cart containing a 25-ft. ladder along Gray's Inn Road. There was a rut in the paving about 1 ft. from one of the tram lines. The rut was about 3 ft. long, 4 in. wide, and 1 in. in depth. One wheel of the truck went into the rut, the hand-cart slewed round, and a passing tramcar drove it through a shop window belonging to the plaintiffs, doing considerable damage.

The Judge found that the L.C.C. was guilty of negligence in failing to keep its part of the roadway level or free from danger to other traffic; he found, however, that the driver of the tramcar was free from blame. He also held that the servants of Mr. Sobey ought to have seen that they did not wheel the truck into the hole, and that as there was plenty of room they need not have wheeled it so close to the tram lines, and they were, therefore, also guilty of negligence. As the accident was held to have happened owing to the combined negligence of Sobey's men and the L.C.C., judgment was given, with costs, against both defendants.

Some interesting cases are on record dealing with accidents to drivers through over-bridges and arches; they illustrate the question of non-feasance, misfeasance, and the effect of statutory duties. In 1889 a carter sued the Wandsworth District Board, which had taken over a roadway passing under an arch, the road at one end of the archway being lower than the other. The carter when passing injured his head at the low end of the archway. It was decided that the road had been dedicated to the public subject to this obstruction, and, therefore, an action could not be maintained. In another case a contractor employed by the Tottenham Urban District Council, when making up a road under a bridge, left a ridge, and owing to the jolting of a passing cart, the driver struck his head against the bridge. It was held that an action lay, as the local authority had, through their contractor, been guilty of negligence in making an obstruction in the roadway. A third case, connected with an archway, was decided by the Court of Appeal in the spring of this year, in which the Finsbury Borough Council was the defendant. In 1918, during the time of the lighting restrictions, the driver of a mail cart had to take a circuitous route owing to the results of a fire, and passed at night down a street that was strange to him. He turned down a side street, and was killed, because his head hit against a low archway. The street lamps had been painted grey, and the driver had not seen the arch. According to the Metropolis Local Management Act, 1855, the Council had a duty to see that their streets were well and suitably lighted, and the Judge decided that an action would lie against a public authority for having done negligently an act which the legislature authorised them to do.

It would seem, on the face of it, unfair to make the Council responsible for an accident during the time of compulsorily-reduced lighting, but it must be remembered that in times of great change or emergency it is impossible to adjust the laws to such conditions, and, therefore, under such circumstances, hardships are bound to occur; and it is remarkable how few the legal hardships have been, considering the peculiar circumstances the country has passed through.

A World's Market in Paris.—The Federation of British Industries has undertaken the direct representation for Great Britain and the Dominions of the Paris "Marche du Monde." The idea of establishing a "World's Market" in Paris was conceived in 1919, and from the first received the close attention and approval of the Federation. After a year's work the scheme has now come very close to practical realisation. The site for the building is being cleared, and contracts for its erection have been placed. Already a very considerable number of American, French, Italian, and other Continental as well as some British firms have reserved space in the "Marche du Monde" when completed.

The Federation recommends manufacturers engaged in, or contemplating, export trade to give the "Marche du Monde" scheme their earnest consideration.

Any further information desired may be obtained immediately on application to the "Marche du Monde" Exhibition Section of the Federation of British Industries, 39, St. James's Street, London, S.W.1.

BUSINESS NOTES.

"Electrical Review" Index.—The Index to Vol. 86 of the Electrical Review has been printed, and copies may be obtained (6d. post free) from the Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

Bankruptcy Proceedings.—J. Jagger (J. Jagger & Co.), electrical engineer and contractor, 28, Northgate, Halifax.—The first meeting of creditors was held at Halifax County Court, last week. The gross liabilities estimated by the debtor amount to £1,358, with £1,303 expected to rank for dividend. Mr. A. Gray was appointed trustee, with a committee.

Cuthbert Joseph Thomas Hayman, 76, Malvern Road, Leytonstone, late 96, Woodhouse Road, Leytonstone, and 1, Goodmayes Road, Goodmayes, electrical engineer.—The following are creditors herein :—

Ford H.	£30	Yallot, J.	£99
Redcliffe, E. A. D.	53	Preferential creditors	16
Strathdee, K.	15		

Liabilities, £221 ; assets, nil.

Company Liquidations.—North British Electric Welding Co., Ltd.—Winding up voluntarily. Draft agreement between the company and the North British Premier Electric Welding Co., Ltd. (now in course of formation) approved. Liquidator, Mr. W. Gilchrist, 30, George Square, Glasgow. A meeting of creditors was called for August 12th. Particulars of claims must be sent to the liquidator by September 30th.

Pearson's Electric Miners' Lamp Manufacturing Co., Ltd. —A meeting of creditors was called for August 10th. Liquidator, Mr. A. E. Green.

H. W. Cox & Co., Ltd.—Meeting of members September 30th, at Twyford Abbey Works, Acton Lane, Harlesden, N.W., to hear an account of the winding up from the liquidator, Mr. B. H. Morphy.

Dissolutions of Partnership.—Wild & Booth, plumbers, hot-water and electrical engineers, 117, Stalker Lees Road, Sheffield. —Mr. D. Wild and Mr. M. Booth have dissolved partnership.

Caisley, Jacques & Co., electrical contractors and motor engineers, 2, Devonshire Place, Grange-over-Sands, Lancashire.—By an order of July 14th of the Lancashire County Court, held at Barrow, in an action Jacques v. R. Caisley and F. W. Kenward, it was declared and adjudged that the partnership lately existing between Mr. J. W. Jacques, Mr. R. Caisley, and Mr. F. W. Kenward, ought to stand dissolved as from June 8th, 1920. Mr. F. J. Harrison, accountant, Ulverston, has been appointed Receiver, and will attend to debts and claims.

Trade Announcements.—The Compression Starter and Switchgear Co., Ltd., of Penny Lane, Lancashire Hill, Stockport, has acquired from Messrs. Ferranti, Ltd., the section of their business relating to direct-current compression motor starters, together with raw material, manufactured parts, machinery, and patent rights relating to these articles. Mr. T. N. Robinson, formerly with the Stockport Corporation electricity department, is managing director of the company.

The Enterprise Electrical Co., Bradford, announce that their new address is at 677, Little Horton Lane.

It is announced that the business of the late Mr. Edward Dewhurst, electrical engineer, of Mount Street and Theatre Street, Preston, and Higher Bank Road, Fulwood, will be continued by the executors.

Mr. C. B. Maurice, of Russell Square Mansions, 122, Southampton Row, W.C. 1, informs us that he has resigned his offices of chairman and director of Messrs. Catchpole & Maurice Ltd., as from 5th inst.

Mr. Ashton Bremner, of 125, Pall Mall, London, S.W. 1, is open to consider agencies for electrical machinery, &c., and will be glad to hear from manufacturers.

Catalogues and Lists.—Messrs. Connolly Bros., 69, St. Stephen Street, Salford, Manchester.—Price list No. 122A, and samples of white, 10 mils. thick, and black, 12 mils., "Nonsol" adhesive rubber insulating tapes.

Messrs. Purit Specialties, Ltd., Park Street, Birmingham.—Illustrated and priced booklet, No. D.L.S. 3, dealing with the "D.L.S." one, two and three-arm lighting fitting. Also illustrated and priced leaflet dealing with "D.L.S." reflectors.

Messrs. Metal Industries, Ltd, Sunbury-on-Thames.—Illustrated booklet on the method of protecting iron and steel from corrosion by "Sherardizing" or dry vapour galvanising, accompanied by a sample of the work.

The British Thomson-Houston Co., Ltd., Rugby.—Illustrated descriptive list, No. 4,221A, on automatic circuit-breakers for A.C. and D.C. circuits.

The National X-Ray Reflector Co., 235, West Jackson Boulevard, Chicago, U.S.A.—Illustrated booklet and detail plates showing examples of lighting from concealed sources.

The General Electric Co., Ltd., 67, Queen Victoria Street, E.C. 4.—Revised catalogue price lists dealing with "Freezor" fans (V. 2 333); bells, batteries, accessories, &c. (L. 2,335); also a "Koolah" fan leaflet (V. 2,338), and a coloured "Efficiency" leaflet (2,336).

The Waltham Manufacturing Co., 2, Jackson Road, Holloway, N.—Two leaflets describing electric arc lamps—automatic and hand-feed—horizontal and vertical. Illustrated and priced.

Sterling Telephone and Electric Co., Ltd., Telephone House, 210-212, Tottenham Court Road, W. 1.—Publications No. 280 and 282—revised price lists of telephone apparatus and accessories No. 281, leaflet dealing with the "Sterling" electric bell indicator (pendulum); illustrated and priced.

Lead.—Messrs. G. Cawson & Co., in their report, dated August 7th, say :—

> The general trade demand remains without any improvement, and we fear it is not likely to improve with holidays and prospects of strikes and labour difficulties in all directions. Engineers in some directions are already on strike, and, should this extend, it will interfere seriously with the demand from electrical works, which at the present is the mainstay of the trade.

Annual Outings.—On Saturday, July 31st, the head office staff of Messrs. Falk, Stadelmann & Co., Ltd., went for an outing to Rye House, Hertfordshire, in 20 privately-hired motor-'buses. The company were entertained to dinner and tea by the directors. After the toast of "The King," proposed by Mr. Max Falk, Mr. J. W. Laidler proposed "The Firm," which was replied to by Mr. Max Falk, the chairman, who pointed out that the firm had one of their first outings to Rye House some 30 years ago, when the guests numbered about 50, compared with 680 on the present occasion. During the day some impromptu sports were held, prizes being presented by the chairman. Other diversions included dancing and boating.

The directors and staff of Sir J. F. Payne Gallwey, Brown and Co., Ltd, consulting engineers, held their annual outing on Saturday last. A party of 50 travelled by charabancs to Windsor, where they boarded a private launch and went for a two-hours' trip on the river, during which time, tea and refreshments were provided, to the accompaniment of a band. A return by charabancs was made to the Clarendon Hotel, Hammersmith, where dinner was served. After the toast "The King," a vote of thanks was passed by the guests.

Disputes.—The *Sheffield Daily Telegraph* says that at the Penistone works of Messrs. Cammell, Laird & Co., a number of electricians who "downed tools" about five weeks ago because a foreman was not a member of the E.T.U. are still out. The firm are endeavouring to carry on without them.

The Sheffield *Independent* says that the dispute has been referred to the Engineering and National Employers' Federation, the Emergency Committee of which called a conference of representatives of the various Trade Unions operating in the Sheffield area, to be held yesterday at York. The Union representatives will be advised as to the policy the Employers' Federation proposes to adopt. The trouble arose over the refusal of one man, who, until recently, was a member of the Electrical Trades Union, to resume his membership of the Union on his promotion to the position of foreman. The Employers' Federation support his action in declining to rejoin the Union, and contend that there should be no compulsion used in respect of staffs joining Trade Unions, particularly the same Unions as the workpeople they control are in. On the other hand, it is alleged by the Trade Unionists that there is a personal element in the matter.

The *Birmingham Post* states that the ballot papers were returnable on Monday from cable workers connected with six Unions on the question of tendering notices to cease work to enforce the claim for an advance of 15s. a week for all workers of 18 and over, and 7s. 6d. to those under 18, with a guarantee of 33½ per cent. for pieceworkers. "The result will be announced, and the next step decided upon at a conference in London on Wednesday of next week. Mr. Kelly (Workers' Union) said that so far as he had seen the returns—and he had seen those from some of the largest districts—there was a preponderating vote in favour of a cessation of work. If all districts were in line with the returns to hand, there was every probability of a large majority for tendering notices. The Unions concerned, in addition to the Workers' Union, are the Electrical Trades Union, the National Union of General Workers, National Federation of Women Workers, National Amalgamated Union of Labour, and Amalgamated Society of India-rubber Cable and Asbestos Workers."

The Glasgow correspondent of the *Daily Herald* reports that a crisis has arisen in the Scottish electrical trades owing to the refusal of the Contractors' Association to grant the demand for a minimum of 2s. 3d. an hour, the rate paid in all the English centres except London. "The present minimum is 1s. 10d.; the employers offer 2s. 1d., to come into force from the date of acceptance. This offer was rejected by the men, who are voting on a proposal to strike to enforce their full demand. About 2,500 electricians are affected, and a number of district meetings have already decided to ask the Union Executive to sanction a strike. The ballot will finish in a few days."

Electrical Wages Agreement.—An agreement has been entered into between the National Federated Electrical Association and the Electrical Trades Union with regard to the standardising of wages nationally. It was signed on August 7th. A copy has reached us at the moment of going to press and we shall quote it fully next week. The schedule rate for Grade A, London, is 2s. 6d. per hour; Grade B, Mersey and other specified districts, 2s. 3d.; Grade C, various specified towns and districts, 2s. 1d.; Grade D, other counties and towns in England and Wales, 1s. 11d.

New Lamp Works.—The British Thomson-Houston Co., Ltd., have entered into a contract with the Chesterfield Corporation for the purchase of over 13 acres of land adjoining the sewage works, upon which it is proposed to erect a factory for the manufacture of electric lamps. It is contemplated that the factory will eventually employ about 1,000 people.

New Italian Companies.—The Società Elettrica della Venezia Giulia has been formed at Trieste, with a capital of 20,000,000 lire, for the production and distribution of electrical energy throughout the province of Venezia Giulia.

Under the style of Soncini e Ca. has been formed at Turin a company, with a capital of 500,000 lire, for the development in Italy and abroad of the Soncini electric resistance furnace.

The Società Anonima Splendor has been established at Milan (Via S. Maria Falcorina) for the manufacture of electrical apparatus. Its capital is 200,000 lire.

With the title of Società Termoelettrica Piemontese S.T.E.P., has been formed at Turin a company, with a capital of 50,000 lire, for the manufacture of electric and heating apparatus.

Tesio, Viola e Billo have formed themselves into a company at Montanera (Mondovi) for the production of electrical energy. Capital, 100,000 lire.

Enrico Knappworst e Ca. have been constituted a company at Milan (10, Via Canova), with a capital of 800,000 lire, for trade in electrotechnical articles.

The Società Anonima Radiotelegrafica Italiana has been established at Milan, with a capital of 200,000 lire, for the manufacture of telegraphic and wireless apparatus.

At Milan (Via Carroccio, 20) has been formed the Industria Milanese Motori Elettrici Rag. G. Bachella, Colombo e Ca., for the construction and repair of electric motors and transformers.

There has been formed at Alba the Società Elettrica Industriale Albese, with a capital of 400,000 lire for the working of refrigerating plants and the distribution of electrical energy.

The Società Imprese Forniture Elettriche, with a capital of 200,000 lire, has been established at Bologna to carry out electric supplies contracts.

The Società Anonima Mulino e Trappeto Elettrico is the style of a company launched at Cupello, with a capital of 100,000 lire, for the erection and working of electrically-driven mills.

Hamilton e Gorman have established themselves as a company at Genoa, with a capital of 100,000 lire, as electrical and mechanical engineers.

There has been formed at Legnano, with a capital of 250,000 lire, the Società Idroelettrica San Giorgio, for the purchase or generation of electric current for illumination purposes.

At Milan (*via* Tadino 52) Dottor Bortini e Ca. has been constituted a company, capital 300,000 lire, for the manufacture of electrotechnical and other scientific apparatus.

The Società Apparecchi di Riscaldamento Elettrico has been established at Milan, with a capital of 200,000 lire, for the manufacture of electric heating apparatus.

With a capital of 310,000 lire, Bianchi, Pozzi, Todeschini e Ca. have been launched as a company at Milan, with works at Crescenzago, for the manufacture of electric station apparatus and for repairs.

New Petrol Engine for Wireless.—A new 2-H.P. two-stroke petrol engine, suitable for wireless telegraphy and telephone work, is shortly to be put on the market by Messrs. C. B. Harrison (1909), Ltd., of the Endurance Works, Sheepcote Street, Birmingham.

New Japanese Enterprises.—Capital invested in banking and other forms of business during the past five months aggregated 2,159,740,000 yen, according to investigations conducted by the Bank of Japan. The figures compiled by the bank show the following for the various lines of businesses for the period, and for the same period of the four preceding years; the figures are on a million yen basis :—

	1920	1919	1918	1917	1916
Banking	201	49	29	39	8
Trust and monetary ..	110	7	—	—	—
Warehousing	36	—	—	—	—
Insurance	11	6	—	—	—
Mining	179	62	108	62	22
Electrical	120	40	—	—	—
Shipping and railways ..	150	54	88	53	10
Fishery	9	4	3	1	—
Manufacturing	679	183	193	220	78
Agriculture	54	8	15	2	—
Commercial	598	123	219	63	16

Reuter's Trade Service (Tokio).

Book Notices.—"Vickers News." Vol. II, No. 21.—The August issue of this well-produced house organ contains articles on "The Building of a Rigid Airship," on the "Rapid Handling of Cargoes by Pneumatic Conveyors," and an account of Messrs. James Booth's non-ferrous metal works at Birmingham, &c.

"Technology Reports of the Tôhoku Imperial University. Vol. I, No. 2. Sendai, Japan: Maruzen Co., Ltd. 1920.—Containing an account of a fundamental study of Japanese coal by Chôzô Iwasaki.

We have received a list of important publications issued by the American Society of Mechanical Engineers, 29, West Thirty-Ninth Street, New York.

"The Engineering Enquiry." By T. Thompson. Bristol: J. W. Arrowsmith, Ltd. Price 7s. 6d.

Scientific Papers of the U.S. Bureau of Standards, No. 383, "Measurement of Hysteresis Values from High Magnetising Forces" (9 pp.), and No. 384 "The Variation of Residual Induction and Coercive Force with Magnetising Force" (8 pp.). Washington: Government Printing Office. Price 5 cents each.

British Industries Fair, 1921.—The *Daily Chronicle* states that the Department of Overseas Trade has entered into a contract for the use of the White City for holding next year's British Industries Fair (February 21st to March 4th).

Private Meeting.—C. W. Dixon, electrical engineer, 1A, Clark's Buildings, Shaftesbury Avenue, London, W.C.—The creditors interested herein were called together recently at the offices of Mr. G. W. Spencer, I.A., 139, Cannon Street, E.C., when a statement of affairs was presented, which showed liabilities of £378. The indebtedness to the trade was £239. The assets were estimated to realise £306, or a deficiency of £72. It was stated that the debtor served for four years in the Grand Fleet, and started in business on his own account in March of last year, with a capital of about £25. Subsequently he borrowed £100 from Mr. E. C. Simon, who was now a cash creditor for that amount. The book debts were all good, while it was anticipated that the stock would realise the amount at which it was set down. After a short discussion, it was decided that a deed of assignment should be executed with Mr. W. Osborne, of Messrs. Corfield & Cripwell, Balfour House, Finsbury Pavement, E.C., as trustee. A committee was also nominated, consisting of the representatives of the Electrical Supplies Co., the Sun Electrical Co., and Mr. E. C. Simon. The following are creditors :—

Electrical Supplies Co. ..	.. £97	Standard Metal Co... ..	.. £11
Johnson & Phillips	.. 16	Woodfall, H.	.. 14
Sun Electrical Co.	.. 69		

For Sale.—Re Lithanode, Ltd. (in liquidation).—The Receiver, Mr. F. A. Bell (of Messrs. J. Baker & Sons, Billiter House, Billiter Street) is offering for sale by tender, by August 25th, the leasehold premises, 190, Queen's Road, Battersea, and 177, Kirkwood Road, Peckham, and the goodwill, plant, machinery, fittings, stock, and patents of the above company.

Cardiff Corporation invites tenders for the following plant installed at Roath power station—two 300-kw. Musgrave-Westinghouse vertical cross-compound 500/550-volt D.C. steam generators, with jet condensers. Full particulars are given in our advertisement pages to-day.

Conditions Relating to Egyptian Government Contracts.—In the Egyptian Journal Official the general conditions under which tenders are received for Government contracts are set out. The conditions include the following :—

The tenderer must be a person residing in Egypt, or must have a representative in Egypt, and will give in his offer an address at which notices may be served upon him. Every tender submitted in the name of an incorporated company must be accompanied by authenticated copies of the documents defining the constitution of the company. Every tender submitted in the name of a private firm or partnership must be accompanied by such extracts, duly authenticated, from the partnership deed as shall suffice to show what persons are authorised to enter into contracts on behalf of the firm or partnership, and what persons are responsible for the due execution of such contracts and can give valid receipts on behalf of the firm or partnership. However, firms established in Egypt and having constant dealings with the Government may deposit with the Ministry of Finance authenticated copies of the above mentioned documents. In submitting tenders, these firms should then simply state that the documents in question have been so deposited, and that no subsequent changes in the constitution of the company, partnership, or firm have taken place. Each tender must be accompanied by a provisional deposit of 2 per cent. of the total value of the offer in money. Post Office orders or cheques on local banks will be accepted, but not cheques on banks abroad. The provisional deposit may be replaced by a letter of guarantee from an approved bank in Egypt to the effect that the bank will hold at the disposal of the Government a sum equivalent to 10 per cent. of the total value of the contract in the event of the tenderer obtaining the same. Letters of guarantee from the banks abroad may also be accepted, but in that case the administration may require the endorsement of such letters of guarantee by an approved bank in Egypt.

Within ten days after the acceptance of the tender a sum equal to 10 per cent. of the total value of the contract will be deposited by the successful tenderer as security for the due execution thereof. This deposit must be either in cash (on which no interest will be allowed) or in Egyptian Government or other approved securities, calculated at market value with a margin of 5 per cent. Cash may be paid to the contracting department or to the Ministry of Finance. Securities will be deposited with the Ministry of Finance, in Cairo, or with the National Bank of Egypt, in Alexandria, or in London, for the account of the Government. The coupons maturing on these securities may be detached by the contractor. The deposit will be retained until the contract has been duly carried out to the satisfaction of the Government.

In the case of unsuccessful tenderers, their provisional deposit, if made in cash, will be returned to them; letters of guarantee will be returned to the bank which issued them, simultaneous notice being sent to the tenderers that this has been done.

Contractors may effect a permanent deposit in cash or securities with the Ministry of Finance, in Cairo, on which certificates for provisional deposits may be granted to accompany their tenders, and also certificates for final deposit of 10 per cent. on value of contract accepted.

Tenderers are permitted to attend when tenders are being opened or be represented by an accredited delegate and hear the prices read out of the various tenders as opened.—*Reuter's Trade Service* (*Cairo*).

Activity of the French Thomson-Houston Co.—The report of the French Thomson-Houston Co. shows that that concern has lately booked some important orders. In the first place, it has secured the order for the equipment of the Gennevilliers super station which the Union d'Electricité are having erected there; also an order for 25,000-KW. turbo-generator groups for the Energie Electrique du Nord Co.; an order for the supply of 50 automotors and 50 trailers for the tramways of Bucharest; an order for telephone material from the Administration des Postes, Télégraphes et Téléphones; and an order for a new set for the central station at Paris. In addition, the company has in hand a by no means small scheme of setting up electric haulage on the canals of the Marne and the Rhone, covering a distance of 350 km.

Auction Sales.—By direction of the Disposal Board, Ministry of Munitions, MESSRS. HARRIS & GILLOW will sell by auction, on August 18th, at Shoreham Camp, Sussex, the camp buildings and equipment, including the main switchboard, electric meters, and other electrical appliances.

ASSETS AUCTIONS CO., LTD., will sell by auction on August 18th, at 119-121, Newington Causeway, a quantity of electrical stores, &c.

By order of the Disposal Board Ministry of Munitions, MR. M. MARSHALL will sell by auction on September 1st and 2nd at the Central Stores depôt, 83, Georgetown, Houston Station, near Glasgow, plant and machinery, including electric motors, generating sets, cable, electric cranes, electric fittings, &c. For full particulars see advertisement pages to-day.

Boiler Makers' Wage Claim Rejected.—The Industrial Court has rejected the claim of the Boilermakers' and Iron and Steel Shipbuilders' Society for an advance of 7s. per week for boilersmiths employed in the running sheds of the Great Western Railway, and of advances varying from 5s. to 3s. for other grades. The rates of pay of the workers concerned, the award states, have been increased by 3s. per week from May 31st under an award relating to railway shopmen. The company contended that no advance should be given to the boilermakers, which would again upset their relationship with other skilled grades, and the Court agrees that it would be unwise to disturb the present relationship between the rates of the various grades of skilled craftsmen.—*Times.*

New Company.—*The Birmingham Gazette and Express* states that under the title of BRITISH TIMKEN, LTD., a new all-British company has just been formed to take over the manufacture of the well-known Timken roller bearings in this country, formerly carried on by the Electric and Ordnance Accessories Co., Ltd. The capital is fixed at £50,000, and the head office and works are at Ward End, Birmingham, where a fully-equipped modern factory is already in existence, manufacturing these bearings on an extensive scale.

LIGHTING AND POWER NOTES.

Australia.—SYDNEY.—In order to avoid seriously overloading the generating plant, the City Council has prohibited the connection of electric radiators to the system during the hours of 8.30 a.m. and 9.30 p.m. on Mondays, Tuesdays, Wednesdays, Thursdays, and Fridays. Owing to the sudden advent of cold weather, this will cause a great deal of discomfort to consumers.

Bexley Heath (Kent).—BULK SUPPLY.—The Urban District Council has abandoned a proposal to obtain a bulk supply from Woolwich owing to the heavy capital charges that would be required for converting machinery.

Bath.—LOAN SANCTIONED.—The Electricity Commissioners have sanctioned a loan of £34,000, part of the cost of new plant, &c. The balance will be sanctioned when the actual cost has been ascertained.

Brighton.—YEAR'S WORKING.—The total income of the electricity department for the past financial year was £158,062, as against £130,557 in 1918-19. Working expenses totalled £105,755, as against £86,476, leaving a gross profit of £52,307 (£44,081). The payment of loan charges and taxes resulted in a net profit of £13,374, an increase of £10,262 upon the previous year's gain. Sales increased by 858,443 units.

Bristol.—JOINT AUTHORITY.—The Council has received a report from the Electrical Committee relating to the recent provisional formation of a Joint Electricity Authority for the Lower Severn or West of England Electricity District. The Minister of Transport is prepared, if the Treasury agrees, to construct transmission lines between Beachley, the Forest of Dean, Gloucester, and the Stroud Valley, at an estimated cost of £365,000, on the understanding that the authority is set up as early as practicable. It is, therefore, expected that local authorities will take the necessary final steps to that end, and the Committee advises that Bristol shall join in forthwith.—*Bristol Times and Mirror.*

Burnley.—LICENSING ELECTRICIANS.—The Burnley and District Building Employers' Association wrote to the local Electricity Committee, last week, asking that the Corporation should obtain powers to examine the qualifications of electricians and others undertaking electrical work in the town, so as to prevent unqualified and unskilled persons doing the work. The Committee decided to take no action, as the Corporation is already empowered to refuse a supply where the lines, fittings and apparatus are not in good condition.

Buxton.—YEAR'S WORKING.—There was a loss of £3,378 on the working of the Council's electricity undertaking during the past year.

Dartford.—LOAN SANCTIONED.—The Urban District Council has received sanction to a loan of £12,106 for electricity purposes.

Doncaster.—LOAN SANCTIONED.—The Electricity Commissioners have formally sanctioned the borrowing of £85,000 on account in respect of the amount of £106,850 included for plant, and state that as soon as the cost of the latter has been approximately ascertained, they will consider sanctioning the balance.

Glasgow.—NEW STATION.—The new station at Dalmarnock, the construction of which has been considerably retarded by the war, is to be formally opened on September 2nd. Its ultimate capacity will be 200,000 H.P., but only half of this plant is installed at present.

Hereford.—SEVERN VALLEY SCHEME.—In consequence of urgent representations to the Electricity Commission, the Hereford electricity undertaking has obtained the sanction of that body to apply for a special order modifying the proposal to include only the Ledbury, Ross, and south-eastern rural part of the county in the Lower Severn Valley supply scheme. Hereford already has a scheme for supplying the whole county, and the Commissioners have now permitted one of the cables to be laid from Hereford, which is able, on the understanding arrived at, to proceed with its entire scheme.—*The Western Mail.*

Hornsey.—LINKING UP.—The Electricity Commissioners have agreed that the Town Council shall retain the electricity undertaking, providing the latter is linked up to the Finchley station. A programme of extensions, which will cost £50,000, has been prepared.

Ireland.—HYDRO-ELECTRIC SCHEMES.—One of the several projected schemes for the utilisation of water power in Ireland is the one which has its base in the locality of the Rosses, County Donegal. The proposal is that Loughanure should be barraged, so that it could be enlarged beyond its present size of three miles in length by three-quarters of a mile in breadth, taking several other streams and lakes into the catchment area. The power of the Loughs Dunlewy and Upper and Lower Nacung could be similarly reservoired and brought to Dowros by a cut, the fall being about 200 ft. Lough Owencarrow, which is part of the Rosses lakes system, could also be utilised, the estimated H.P. of the lakes mentioned above being nearly 5,000. The County of Donegal is rich in short swift running rivers, and their amalgamated energy would not be far short of 12,000 H.P. The swift rivers which empty into Gweedore Bay could be used for industrial purposes, and the co-operative system which has such a hold in the Rosses could be more fully expanded.

Kingston-on-Thames.—LOAN.—An inquiry was held last week into the application of the Town Council for a loan of £15,200 for electricity purposes. There was no opposition.

Knaresborough.—WATER POWER.—The District Council is in negotiation with Messrs. Vickers, Ltd., about the cost of a scheme for generation of electricity for town supply by utilising the water power of the River Nidd. An expert has suggested that the provision of "flash-boards" 1 ft. deep on the crest of the weir would give a 10 per cent. increase of power, but would probably put the boat landing stage, one of Knaresborough's chief attractions to pleasure seekers, under some inches of water. The most economic position for the plant, it was thought, would be the existing turbine-house at the linen mill of Messrs. Carson, and the firm is to be approached on the matter.

Korea.—HYDRO-ELECTRIC SCHEME.—A hydro-electric power scheme is contemplated on a large scale, with the object of utilising the waters of the River Hwangsu-won, a tributary of the River Yalu in South Hamkyeng (Kankyo) Province. The project is backed by the Oriental Development Co., and the capital to be raised is 10,000,000 yen. The Province of South Hamkyeng is rich in timber and minerals, and it is anticipated that there will be a large demand for electrical power. It is calculated that the installation will take three years to complete. The principal items of expenditure will be the power station, 3,153,850 yen; transmission plant, 975,000 yen; and distribution plant, 366,435 yen. It is understood that the scheme has been approved by the authorities of the Government-General.—*Board of Trade Journal.*

Leicester.—NEW STATION.—The scheme for the erection of an additional generating station having been sanctioned by the Electricity Commissioners, formal application is being made for power to borrow £723,000, the estimated cost of the undertaking.

Liverpool.—NEW HOUSES.—The Lighting Committee has instructed the city electrical engineer to carry out the work of wiring the new houses that are being built.

Maxwelltown.—STREET LIGHTING.—The Town Council has accepted the offer of the Dumfries Electricity Supply Co. for street lighting, at a cost of £940 for the installation, and energy at 4½d. per unit.

North Wales.—Electricity District.—At a recent meeting of the Anglesey County Council the opinion was expressed that North Wales should be constituted a separate electricity district instead of being grouped with Crewe, Chester, Northwich, &c., as proposed. The Electricity Commissioners did not concur in this, and it was, therefore, decided to ask all the County Councils of North Wales to send delegates to a Conference, with the object of protecting the interests of their areas.

New Zealand.—Wellington.—The Wellington City Council has decided to borrow £300,000 for the purpose of extending the city's power plant. The scheme includes the installation of one 3,000-kw. and one 1,500-kw. steam generating set.—*Reuter's Trade Service*, Wellington.

Oldham.—Applicants' Protest.—The Electricity Committee last week received complaints from would-be consumers, pointing out that although applications for supplies were granted in March, there had been no connections made yet. It was contended that the Committee should have told consumers of the dispute between the Electrical Trades Union and other workers. The Mayor said the matter was getting serious. Some time ago the E.T.U. stated that it would not connect up any work that had been done by either plumbers or non-Unionists. With a little reason on both sides, perhaps they could get out of the difficulty. The Mayor, vice-chairman and the engineer were appointed a sub-committee to interview the local Union.

Portishead.—Change of System.—The Urban District Council has assented to the North Somerset Electricity Supply Co. changing the system of supply from d.c. to a.c.

Rickmansworth.—Time Extension.—The promoters of the Rickmansworth and Chorleywood Electric Light Order, 1914, having applied for a further extension of time for carrying out the Order, the Urban District Council has informed the Commissioners that it considers that the time has arrived when the compulsory works should be carried out, or the Order cancelled.

St. Anne's.—Year's Working.—The report for the year ended March 31st, 1920, shows a total revenue to the electricity department of £27,546, compared with £22,722 in 1918-19. Expenditure totalled £22,467, as against £18,989, leaving a gross profit of £5,079 (£3,733). The net result was a profit of £132.

Sumatra.—Hydro-Electric Power.—In connection with the concession granted for the purpose of generating hydro-electric power, needed for the manufacture of fertilisers, from the river Moesi, near Benkoelen, several features appear to be of unusual interest, and, it is stated, will result in considerable saving of cost in the construction of the works.

Amongst others, special mention may be made of the manner in which the dam will be built across the absolutely dry bed of the river, as well as of the proposal to make use of a by-station of 50,000 h.p. in the second year of the work, so that the manufacture and organisation at the factory may be running smoothly, and a return be obtained upon the outlay long before the full power can be available for use.

The surveys for the scheme are not yet completed, but it is stated that 150,000 h.p. will be obtainable from the turbines, at a cost of, in all probability, 100 guilders per h.p., and of not more than 133 guilders.

The cost of power per kw.-year is estimated to be about 12 guilders.

Several large firms of manufacturers in the United States are stated to be endeavouring to find capital to finance the scheme in the hope of thus being able to supply the necessary plant both for the works as well as for the construction of the same.—*Board of Trade Jurnal.*

Warrington.—Extensions Needed.—Representatives of the big Warrington manufacturing firms have met members of the Corporation Electricity and Finance Committees to discuss proposals with reference to the extension of the electricity works. The general opinion was that large and immediate extensions, which would involve a considerable expenditure, were necessary. The meeting was adjourned to enable the Corporation to submit proposals to manufacturers individually, and to ascertain how they could assist in financing the scheme. In the event of the proposals going forward, one firm is prepared to assist to the extent of £50,000.

West Ham.—Year's Working.—The report on the electricity undertaking for the year ended March 31st last records a total income of £380,013, as against £253,914 for the previous period. The working expenses amounted to £310,777, compared with £227,312 for 1918-19, leaving a gross profit of £69,236, as against £26,602. The net result, after payment of loan charges, &c., was a profit of £14,350, comparing favourably with last year's deficit of £24,975. The total number of units sold rose from 38,216,253 to 41,628,476.

Wrexham.—Inquiry.—The Ministry of Health recently conducted an inquiry into the circumstances under which the Corporation sought sanction to a loan of £17,260 for a boiler and accessories. The inspector considered that the Corporation had fully established its case, and thought it rather wonderful that the supply had been uninterrupted under such a handicap. The chairman of the local gas company urged an increase of charges, as the undertaking had cost the ratepayers £6,000 in working losses.

TRAMWAY AND RAILWAY NOTES.

Bolton.—Extensions.—There is every prospect of a through tramway service from Bolton to Accrington as the result of a Bill which is being promoted by Bolton Town Council for dealing with tramway extensions.

Brighton.—Strike.—The tramwaymen struck work at midday on August 5th, and returned the cars to the depôts. The trouble arose over grading for wages purposes; the men complained that they had been placed in Grade 2, while Portsmouth, Southampton, Bournemouth, &c., men were in Grade 1. The amount in dispute was 1s. per week.

Alderman Carden offered personally to pay the extra 1s. for a month, and to refer the matter back to the Industrial Council, but said he could not go behind the award of that body. The men refused the offer.

The men eventually agreed to resume work on August 9th, the Tramways Committee having promised to give their claims full consideration.

Tramway Fares.—There may be a distinction between the Corporation tramway fare to the racecourse and profiteering, but without some explanation, says the *Daily Mail*, it is far too subtle for popular understanding. Ordinarily the fare is 2d.; on race days it used to be 6d., but last week it was 1s.

Colchester.—Loss of Traffic.—The recent increases in the tramway fares have resulted in a falling off of traffic to the extent of 10,000 passengers per week.

Continental.—France.—The Compagnie d'Orléans, which proposes to electrify 3,350 km. of its 7,787 km. system, has received permission to establish the requisite seven power stations on the Upper Dordogne and on its connecting lines Chavanon and Rhue. All the sections between Chateau-Roux in the north, Limoges, Perigneux and Agen in the east (with two spurs to Poitiers and Angoulême) down to the frontiers of the Midi, and the Paris-Lyon-Méditerranée railways in the south and east will be electrified. Initial power requirements are estimated at 280 mill.-kw.; for a later date at twice that figure. The annual saving in coal will be about 1·5 mill. tons.—*Economic Review.*

Spain.—For the past ten days the electric tramways service of Lisbon has been completely paralysed, owing to a dispute between the company and the Municipal Council.—*Reuter's Trade Service*, Lisbon.

Darlington.—Extensions Deferred.—At a meeting of the Corporation on August 15th, the decision arrived at at the previous Council meeting to extend the tramway system from the Market Place to the Victoria Road entrance of Bank Top Station, at an estimated cost of £15,000, was rescinded.

Doncaster.—Wages.—The tramwaymen are asking for an increase in wages over and above the recent award. The matter is being negotiated upon, but it is stated that if an agreement is not come to the men have threatened to strike.

Halifax.—Fare Revision.—A proposal to restore the old pre-war stages, doubling the 1d. stages and permitting the overlap system, has been carried.

Lincoln.—Year's Working.—The report on the tramway undertaking for the year ended March 31st last shows a total revenue of £14,800, compared with £14,193 in 1918-19. Working expenses amounted to £11,887, as against £8,280; a gross profit of £2,913, against £5,913 in the previous year. The net result was a credit balance of £313. Last year £3,236 was transferred to the depreciation account.

Liverpool.—Purchase of Light Railway.—The Ministry of Transport has forwarded to the Liverpool Tramways and Electric Power and Lighting Committee sanction to borrow £18,350, repayable in 30 years, for the purpose of acquiring and developing the Liverpool and Prescot Light Railway.

Oldbury.—Time Extension.—The Birmingham Council has applied for a year's extension of time for constructing the light railway to Quinton, *via* Warley.

South Africa.—Railway Electrification.—The announcement that the South African Railway authorities intend to proceed at once with the electrification of the Cape Town—Simonstown suburban line and the Natal main line from Durban to Pietermaritzburg, is of importance. The Union's railway administration will acquire experience with electrical working in the case of two sections of entirely different type—a suburban line with fairly dense passenger traffic and a difficult length of main line with severe gradients and curves and a very heavy freight traffic. Two large coal-burning power stations at Cape Town and Durban will be required in connection with the electrification scheme, and the necessary plant, together with the transmission and motive equipment, will represent a series of attractive orders. There will be keen competition for the large contracts involved. The unsatisfactory performance of recently-imported locomotives from the United States may add to the likelihood of these orders being placed with British firms, but they will not come to this country unless the price and date of delivery quoted by United Kingdom manufacturers are satisfactory.—*Times Trade Supplement.*

Stockton.—Tramway Sale.—At a meeting of the Town Council, on the 3rd inst., the award of the arbitrator on the acquisition of the local tramway systems by the Corporations of Stockton, Thornaby, and Middlesbrough was submitted. The price to be paid by the three Corporations is £390,456, in addition to which an amount is to be paid for stocks upon valuation, to be made at the time of transfer. The costs of the arbitration have also to be borne by the Corporations. The capital expenditure of the Tramway Co. was £282,948, and its claim was for £563,340; the Corporations offered £281,766.

Electric Vehicles.—Subject to the sanction of a loan, the Town Council has decided to purchase, at £1,497 each, two two-ton electric vehicles for the collection of refuse.

South America.—Railway Electrification.—A contemporary states that a contract, amounting to nearly $2,000,000, for the electrification of the first main-line railway has been awarded to the International General Electric Co., over the line of the Paulista Railway Co. between Jundiaby and Campinas, Brazil, a distance of 54 km., or about 28 miles, or of double-track construction the total mileage, including switches and extra track, amounts to 76 miles. The equipment to be supplied consists of eight freight and four passenger engines, material for the transmission line and sub-station, and a 3,000-volt overhead equipment. The project anticipates further extensions amounting to 100 additional miles of route, which may eventually bring the total electrification up to 128 miles, extending between Jundiaby and San Carlos. Power for the operation of the lines will be supplied by the San Paulo Light and Power Co. at 88,000 volts, 60 cycles. The locomotives will be of the geared type, 3,000-volt, D.C.! The freight locomotives will weigh 100 tons each, all weight on driving axles, and the passenger engines 120 tons, equipped with two axle guiding trucks at each end. All of them will be equipped with regenerative braking apparatus. The design parallels closely the Chicago, Milwaukee and St. Paul electrification, while the locomotives will be almost duplicates of those used so successfully in the Butte, Anaconda and Pacific Railway, except for slightly increased weight and the addition of regenerative braking. It is expected that the new line will be in operation in July, 1921."

St. Helens.—Leasing of Track.—The Tramways Committee recommends the leasing of the track and equipment from Brooks Bridge to the King's Arms to Liverpool Corporation.

Sunderland.—Holidays.—There is some prospect that the strike of skilled men at the Corporation tramcar sheds will be settled by a compromise. The men struck over three weeks ago because of the refusal of the Corporation to grant 12 days' annual holiday with pay, which had already been conceded to skilled men in non-trading departments, on the ground that it was never intended to give the holiday to these men. This led to a fresh application from all the men concerned for a holiday, and a special committee has decided to recommend the Town Council to grant seven days' annual holiday with pay to skilled men in all departments of the Corporation—including tramways—providing they have 12 months' consecutive service with the Corporation. If the Council approves the recommendation, the men will probably accept it.

TELEGRAPH AND TELEPHONE NOTES.

Canada.—Press Conference.—On the opening day, August 5th, of the Imperial Press Conference at Ottawa, greater facilities for the interchange of cabled news was discussed. The present condition of cables was worse than that prevailing before the war, it was said, and Sir C. Stuart, representing *The Times* and *Daily Mail*, in seconding a resolution that was carried unanimously, "that the Empire and the world should be provided with the advantages of wireless telegraphic and telephonic communication," said, however, that the newspapers were diffident about the use of wireless for the transmission of news, as it was a medium which might be tapped by rivals. Mr. Burroughs, news manager of the Marconi Co., explained that there was no danger of high-speed wireless messages being tapped. The Conference disposed of the cable question by a resolution calling upon the Empire Union to take immediate steps to secure facilities for better, quicker, and cheaper conveyance of news throughout the Empire.

Devizes (Wilts.).—Wireless Station.—The wireless station which was erected during the war, but was not completed, has been taken over by the G.P.O., and is to be refitted by the Marconi Co. for long-distance communication (1,000 miles) with vessels at sea.

Finland.—New Cables.—The "Store Nordiske" Telegraph Co. is to erect a new cable station at Helsingfors. The agreement with the Finnish Government is valid for 20 years. A similar arrangement has been made with Latvia, where a new station commenced operations in May of this year. Agreements have been concluded with Esthonia, Lithuania and Poland. The company has issued credits to Finland of Kr.4 million for the construction of new telegraphic and telephonic lines of communication. It has issued loans to various foreign States for this purpose, amounting in all to Kr.16 million.—*Economic Review.*

France.—Commercial Wireless.—In order to improve the Lyons silk market, a request has been made to the postal authorities for permission to use the wireless station near the city for the transmission of daily market rates to and from the Far East. It is found that a delay of 10 or 12 days necessitated in the case of messages by cable, seriously hampers business. The wireless station is already used by a Japanese business agency and by the American Press.—*The Times.*

India.—New Telephone Service.—On July 1st last a new trunk telephone service, with a charge of 1 rupee for a three-minute conversation, was opened to the public between Bombay and Poona.

Italy.—New Telephone Service.—The Italian Government is occupied with a scheme to establish telephonic communication with Albania (telegraphic connection already existing). The projected line will start from Rome, and will be carried under the sea to Valona, and end eventually at some important Greek centre. The exact length of the existing Otranto-Valona telegraphic cable is 99 km., but a new point of departure will probably have to be chosen for the telephone line, the length of which, in consequence, may be about 106 kilometres. The Società Pirelli has been instructed to draft the necessary plans.

Malta.—Secret Wireless.—A wireless telegraph outfit has been discovered by fishermen off Melleha Bay; it was anchored in 20 fathoms of water with the masts and working parts below the surface to a depth of 8 fathoms. The apparatus, which is said to be complete in every detail, and of German manufacture, was removed by the dockyard authorities for expert examination.

Ships' Wireless.—New Rules.—The Board of Trade has made new rules under the provisions of the Merchant Shipping (Wireless Telegraphy) Act, 1919, which refer to the provision of wireless telegraphic apparatus, operators, and watchers on board coasting trade vessels exclusively employed between ports in the British Isles. The rules, dated July 10th, 1920, will come into operation, says the *Board of Trade Journal*, on September 1st, 1920, and will apply to vessels carrying under as well as over 50 persons, including the crew.

Telephone Service.—The P.M.G. in Parliamentary papers states that the number of telephones per 100 of the population is approximately as follows: U.S.A., 13.6; Sweden, 6.4; Norway, 4.4; Germany, 2.2; United Kingdom, 2; France, 1; and Italy, 0.3.

United States.—Telephoning over E.H.T. Lines.—At last successful telephone communication has been conducted over live high-tension lines by the American Gas & Electric Co., which has been convinced thereby that the method employed will solve one of its most important problems, namely, insuring a reliable and less expensive mode of communication between its load dispatchers and interconnected stations. The test which proved the practicability of the method was conducted during July, says the *Electrical World*, between two of the company's stations, over a live 11,000-volt, 60-cycle transmission line, 12 miles (19.2 km.) long. Between the transmitting and receiving sets were the windings of the power transformers at both ends of the line and an underground cable, making the equivalent length of transmission about 21 miles (33.6 km.). The system employed works on the principle of the wired or directed wireless, and involves the use of apparatus to tune out the power-circuit frequency. The carrier current for the communications had a frequency in excess of 5,000 cycles. The transmitting and receiving sets were connected with the 2,300-volt buses at each station, but they could have been attached to the 440-220-volt circuits with just as satisfactory results according to engineers who have developed the system. Owing to the fact that the invention is still in the patent stage, details of the apparatus and connections cannot be obtained at this time. Among the chief advantages of the scheme are that the investment and maintenance expense connected with private telephone lines are eliminated, the necessity of paying high rental charges for leased telephone lines is avoided, no interference from power circuits or static is experienced, no disturbance to neighbouring telephones is produced, the system can be used with any voltage transmission, the possibility of the power circuits breaking is remote, and even if they all fall to the ground communication can still be maintained provided there is not a dead earth on the lines. The investment for apparatus will be only about $500 a station, that is more economical than an ordinary wired telephone system, and especially so the further apart the stations are. According to the operators who communicated over the system the audibility is higher than with ordinary telephones. The American Gas & Electric Co. is planning to apply the communication scheme to all of its properties in various parts of the United States for system load dispatching.

New Cable Dispute.—American destroyers are patrolling the Florida coast to prevent the British cable ship *Colonial* (which has been instructed by the British Embassy at Washington to suspend operations pending further instructions) landing a cable at Miami which the Western Union Telegraph Co. is laying from Barbados to connect with the British cable from the latter place to South America. The U.S. Government's intention is to prevent the laying of the cable pending the meeting of the International Communica-

tions Congress at Washington on September 15th, when the matter is to be discussed. A British cable company has a virtual monopoly of cable rights in Brazilian waters, although an American concern desires to initiate a direct line from the U.S.A. to Brazil. Permission to land the cable has, therefore, been deferred pending the determination by the State Department whether the terms of the Western Union Co.'s arrangment with the British company would not further extend the British monopoly.

Wireless-steered Ship.—Some time ago the U.S.A. Naval authorities announced that the old battleship *Iowa* was to be fitted with apparatus to permit of her being steered by wireless telegraphy. It is now announced that when her boilers have been converted to burn oil, she will be used as a target by the Atlantic Fleet, and will be controlled by wireless.

Wireless Telegraphy.—P.M.G.'s Certificate.—H.M. Stationery Office has issued an official pamphlet (ref. (37) 10,820 Wt. 2,136, 451/582) on the impending changes in the scope and method of conducting examinations for the P.M.G.'s certificate in wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes. Specifications &c., will be available at Australia House, Strand, W.C.—*Reuter's Trade Service.* (Brisbane).

Birmingham. — September 1st. Salvage Committee. Two 100-kw., 440-v., d.c., compound-wound, steam-driven generating sets, complete with surface condenser and switchboard. (July 30th.)

Blackpool.—August 27th. Corporation. Two water-tube boilers, superheaters, economisers, stokers, &c.; two sets of induced draught plant; coal conveying, &c., plant. (July 16th.)

Bradford. — September 9th. Electricity Committee. Contract R. 159. No. 4 boiler house and equipment, including buildings, water-tube boilers, economisers, induced draught plant, feed pumps, coal-handling plant and piping systems. (August 6th.)

Chile.—February, 1921. The Chilean Legation at Paris (23, Avenue du Bois de Boulogne) is asking for tenders for the supply and installation of electric power in the first zone of the Chilean railways. Sealed tenders are returnable before February 1st, 1921.

Croydon. — September 8th. Tramways Department. Supply and installation of a new feeder cable. (See this issue.)

Dublin.—August 17th. Electricity Supply Committee. Soot evacuating apparatus of the Vulcan type. (See this issue.)

Edinburgh.—September 6th. Electricity Department. Converting plant for Portobello generating station and sub-station. Specification No. 26. (August 6th.)

France. — Paris. — September 1st. Supply of three tenders for multiple-commutator switchboards, for the central telephone offices at Saint Germain-en-Laye, Montreuil-sous-Bois and Boulogne-sur-Seine respectively. Particulars of the Direction de l'Exploitation Téléphonique, 4e Bureau, 103, Rue de Grenelle, Paris.

London. — Walthamstow. — September 8th. Urban District Council. Electricity Department. Two water-tube boilers and economisers; one 5,000-kw. turbo-alternator and condensing plant; one 1,500-kw. and one 1,000-kw. rotary or motor converters; one natural-draught cooling tower; e.h.t. and l.t. switchgear; e.h.t. cables. (See this issue.)

Manchester. — August 30th. Electricity Committee. Barton power station: 33,000-volt, 3-phase trunk feeders (26 miles), pilot cables (104 miles), telephone cables (19 miles). Specification B. 7. (August 6th.)

August 24th. Electricity Committee. One steam turbine-driven boiler-feed pump, for Stuart Street generating station. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall. Deposit £1 1s. (returnable).

September 2nd. Markets Committee. Pumps, motors and fittings, for Smithfield and Elm Street cold stores. Specifications, &c., from General Superintendent, Markets Department, Town Hall.

September 20th. Electricity Committee. Six 33,000-volt, 19,500 k.v.a., 3-phase static transformers, house service and testing transformers. (August 6th.)

Nuneaton.—September 20th. Electricity Department. h. and l.t. switchgear, connecting cables and accessories. (See this issue.)

Portsmouth. — August 17th. Tramways Committee. Stores for twelve months, including insulating materials, overhead line equipment, &c. (July 30th.)

August 25th. Electric Lighting Committee. One 4,000-kw. turbo-alternator; two water-tube boilers, each of 30,000 lb. per hour capacity. (July 30th.)

South Africa.—Johannesburg.—September 6th. Gas and Electric Supply Department. Class A. One or more light electric passenger vehicles. Class B. One or more light electric delivery vehicles. (See this issue.)

Spain.—September 21st. Spanish Department of Public Works in Madrid. Concession for the construction and working, during a period of 60 years, of an electric tramway between Mataro and Agentona (Province of Barcelona).

Stockton-on-Tees.—August 30th. District Fund, Gas and Electricity Committees. Articles and stores for six months. (See this issue.)

Uganda.—December 20th. Government of the Uganda Protectorate. Tenders invited for a concession of a portion of the Ripon Falls of the Nile. See this column in our issue of July 30th.

Warrington.—September 7th. Electricity and Tramways Committee. Surface condensing plant. (August 6th.)

CLOSED.

Aberdare.—

Overhead equipment, underground and overhead feeders, for tramways extension.—Messrs. Clough, Smith & Co., Ltd.

Basingstoke.—

Contract for lighting of St. Stephen's Chapel; also for lighting of houses under housing scheme, placed with Messrs. Bennett, Bardwell & Co.

Blackburn.—Corporation:—

Installation of electric lighting in municipal houses in Green Lane.—Jos. Cort (Darwen), Ltd.

Canterbury.—Town Council:—

Electric water-van.—Messrs. Newton, £1,123.

Dartford.—Urban District Council:—

General Electric Co., Ltd.—Rotary converter, £7,125.
Johnson & Phillips, Ltd.—Cable and switchgear for converter, £1,228; mains extensions, £1,237.

Liverpool.—Mersey Docks and Harbour Board:—

Metallic-filament lamps.—The Corona Lamp Works, Ltd., and the Electric Lamp Factors, Ltd.

Manchester.—Tramways Committee.—Accepted:—

Tramway rail bonds.—British Insulated & Helsby Cables, Ltd.

Electricity Committee. Accepted:—

Two 2,350 k.v.a., 3-phase transformers.—Ferranti, Ltd.
Cable.—Enfield: Ediswan Cable Works, Ltd., Connollys (Blackley), Ltd.

Cable and stores for 12 months to June 30th, 1921:—

Cable.—British Insulated & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.; Western Electric Co., Ltd.; Enfield Ediswan Cable Works, Ltd.; Johnson & Phillips, Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Macintosh Cable Co., Ltd.; New Gutta-Percha Co., Ltd.
Adhesive tape.—L. Andrew & Co.
Blackley's tape.—Connollys (Blackley), Ltd.
Dry batteries and flash lamps.—Siemens Bros. & Co., Ltd.
Box compound (for E.H.T. work), resin oil and Bettete tape.—Callender's Cable & Construction Co., Ltd.
Box compound (for L.T. work).—Dussek Bitumen Co.
Carbon brushes.—Le Carbone, Morgan Crucible Co., Ltd.
Crucibles.—Morgan Crucible Co., Ltd.
Dynamo brushes and copper tape brushes.—W. Patterson, Ltd.
Earthenware cable bridges.—Doulton & Co., Ltd.
Earthenware pipes and bends, &c.—Doulton & Co.; Isherwood Bros., Ltd.
Fuse boxes (six months only).—Siemens Bros. & Co., Ltd.
Insulating cloth.—L. Andrew & Co.
Insulators.—Bullers, Ltd.; Doulton & Co., Ltd.
Auto-balancers and auto-transformers.—General Electric Co., Ltd.
Static transformers.—Ferranti, Ltd.
E.H.T. trifurcating boxes.—British Insulated & Helsby Cables, Ltd.
L.T. trifurcating boxes.—Johnson & Phillips, Ltd.
Tubing and accessories.—Brotherton Ediswan Tubes & Conduits, Ltd.
Tubing and fittings.—Simplex Conduits, Ltd.
D.C.C. wire (six months only).—London Electric Wire Co. & Smiths, Ltd.
Wire (resistance and bending).—Bruntons, Connollys (Blackley), Ltd.
Fuse wire.—Hawkins Bros. & Co.; Ltd.; F. Smith & Co.
Main and auxiliary switchgear for Barton Station.—British Thomson-Houston Co., Ltd.

Housing Committee. Accepted:—

Electric lighting of houses on the Mount Road Estate, Gorton.—J. Armstrong.

U.S.A. Generating Station Statistics.—According to reports filed with the Public Service Commission, the gas companies and electricity works in New York City in 1919 consumed a total of 3,453,408 tons of coal. Of this quantity the gas companies used 1,645,619 tons of coal and coke, and the electricity works used 1,806,789 tons of anthracite and bituminous coal. Figures based on reports obtained from over 3,000 central stations give an average, says *Power*, of 3 lb. of coal per kw.-hour; the most economical plants operate on about 1·5 lb. An analysis of 60 of the large electrical power systems in the U.S.A. shows that 49 generate at 60 cycles, six at 25, four at 60 and 25, and one at 50 cycles a.c. There are approximately 4¼ million k.v.a. of 60-cycle, 1¼ million k.v.a. of 25-cycle, and 160,000 k.v.a. of 50-cycle generating capacity installed on these systems.

PROF. JOHN PERRY, D.Sc., LL.D., F.R.S.

By Prof. H. H. TURNER, F.R.S.
(General Secretary, British Association.)

The comparatively sudden death of John Perry came as a great shock to his many friends. It is true that he had been already six years in retirement from active teaching, that his years had reached three-score-and-ten, and that he was not robust; but nevertheless, vitality seemed to radiate from him; no company could be insensible to the keen interest which beamed from his spectacles, or to his jolly laugh; and if the conversation should drift towards controversy, in which Perry's Irish blood seemed to delight, even opponents could enjoy the aggressive things said with so much good humour (in all senses). In Perry's presence there was nothing to suggest collapse. But the trouble which recently led him to take a long voyage was apparently more serious than was thought; he returned without much benefit, ultimately took to his bed, and, after a few days' serious illness, died peacefully on August 5th.

The most important link with the outer world thus snapped is his Treasurership of the British Association, which he took over from Carey Foster in 1904. He was earnest in this work as in all other, and was gathering funds with which to meet the emergency caused by the war. But his interest in the work of the Association did not begin or end with this office; as President of the Education Section, he gave a vigorous address at Sydney, in 1914; and he presided over the Engineering Section, in 1902, at Belfast, in the very lecture-room in which he had begun his own early studies in 1863. His address on the training of engineers opened a discussion (jointly with the Education Section) on that great topic. Perry caught the attention of his audience by quoting from H. G. Wells the distinction between the "degraded, useless, luxurious, pleasure-loving people doomed to the abyss" and the "salt of the earth, or saviours of society," who had an engineer's training and possessed the engineer's methods of thinking; and thereupon proceeded to recall the debt he owed to James Thomson and others who had taught him, and to appreciate their methods. "They revealed to the student that he himself was a man, that mere learning was unimportant, that one's own observation of some common phenomenon might lead to important results unknown to the writers of books." Perry was warm and generous in his acknowledgments. It has often been stated that he had the first public school physical laboratory at Clifton in 1871, and the first school workshop; but in a footnote to this address he acknowledges the priority of the Rossall workshop, and continues: "These ideas were not mine; they were those of the head master" [Dr. Percival].

It was natural that such a man should do specially good work in collaboration, and his partnership with Ayrton is world-famous. It began in Japan, whither he went in 1875, after four years' work as a schoolmaster at Clifton. It is noteworthy that Dr. Percival, who had a keen eye for ability in his staff, appointed Perry at the early age of 20 to carry out the novel ideas above mentioned. But he felt the need of a wider horizon, and ultimately joined the small band of teachers invited by Japan to instruct them in Western civilisation. The instruction was so effective and so rapid that the Japanese Government soon found itself able to bid a courteous farewell to its benefactors, and entrust the continuation of the good work to their pupils. But the teaching was, nevertheless, so far from absorbing all the available energy, that a stream of important memoirs issued from the same source. [Possibly their production was a not unimportant part of the teaching.] Ayrton and Perry, for instance, made the first determinations of the dielectric constant of gases, and there followed an important memoir on the significance of this constant in the definition of the electrostatic unit of quantity. They wrote on the viscosity of dielectrics, the theory of terrestrial magnetism, electrolytic polarisation, contact electricity, telegraph tests; the volume of work was so great as to draw from Clerk-Maxwell the jest that the "centre of electrical gravity seemed to have shifted to Japan." Things specially Japanese were not neglected; the partners gave an ingenious solution of the problem of Japanese "magic" mirrors, and joined in the general interest in earthquakes. Perry continued to follow the seismological work of his friend Milne till the day of his death, and Milne's 1896 Seismological Report contains the description of a "Perry tromometer," the only fault of which seems to have been its too great sensitiveness. The collaboration with Ayrton survived the return of both partners to England; together they invented a surface-contact system for electric railways, which guaranteed an absolute block, and on taking over telpherage after Fleeming Jenkin's death they used this device. They invented a clock meter and motor meter, from which, owing to the vagaries of patent laws, other people made vast fortunes; and they produced the first electric tricycle in 1882. After producing more than 70 memoirs, the partnership was dissolved soon after their ammeter received a silver medal at the Paris Exhibition of 1889, the last joint paper appearing in 1891, after which date they found it more convenient to work separately. But the friendship was not dissolved, and Perry was one of the friends chosen to make Ayrton's funeral orations.

He has told, with much enjoyment at the recollection, the story of his first meeting with Sir William Thomson, with whom he worked for a time in 1874-5, and for whom he always retained the deepest veneration. Thomson having come across a question to which he understood Perry had paid some attention, he wrote to ask him to call, and left word with his servants and assistants that Perry was to be admitted whenever he should appear. This happened to be when Thomson was giving a lecture, but the instructions were carried out, and suddenly Perry found himself in the presence of a large class, for whose benefit Thomson was writing on the blackboard. Without the least hesitation or embarrassment the lecturer asked the class to excuse him for a few moments, rubbed the board clean, and used it to make diagrams of the matter on which he wished to consult his visitor!

Perry left Japan in 1879. Ayrton had come home the year before, and (with H. E. Armstrong as the only other Professor) had started technical instruction at what came to be the City and Guilds of London Technical College, Finsbury, his first class consisting of one old man and a boy of 14. Perry joined him in 1881, and under these three great educational pioneers—Ayrton, Armstrong and Perry—progress was very rapid. Perry remained 15 years at the College, and while there wrote his "Practical Mechanics" (1883), and his well-known "Spinning Tops" (1890), the latter being substantially a British Association lecture to working men. But his appointment at the Royal College of Science in 1896 led to a more copious educational ouput. "The Calculus" and "Applied Mechanics" both appeared in 1897, "Steam and Practical Mathematics" in 1899, and "England's Neglect of Science" in 1901, the year in which, at the Glasgow meeting of the British Association, he opened a crusade for the better teaching of mathematics—a crusade still in vigorous prosecution, though its opener be now gone. Probably the effects of Perry's educational work will be even more permanent than his engineering achievements, though these extended to the close of his life, which was marked by a notable contribution to the theory and the practical improvement of the gyrocompass.

Again, we note that this last work was done in the happiest circumstances of collaboration—with his nephew by marriage, Mr. S. G. Brown, F.R.S. A few dates and details may be added: he was born in Ulster on February 14th, 1850, the second son of Samuel Perry, of Garvagh. Ability has shown itself in several other members of the family, both in his own generation and the next. He married Miss Alice Jowitt, of Sheffield, who died in 1904, and was buried in the churchyard at Wendover, where they had a country cottage; there, too, her husband was laid on August 8th. There were no children. In boyhood, Perry attended classes at the Model School, Belfast, and later went to Queen's College. He was a Whitworth Scholar, Peel's Prizeman and Gold Medallist. He was elected F.R.S. in 1885, and received honours from various Universities. An invitation to receive an Honorary Degree from the University of South Wales reached him, and gave him pleasure only a few hours before his death.

NOTES.

Parliamentary.—Royal Assent.—The Royal Assent has been given to the following Acts :—

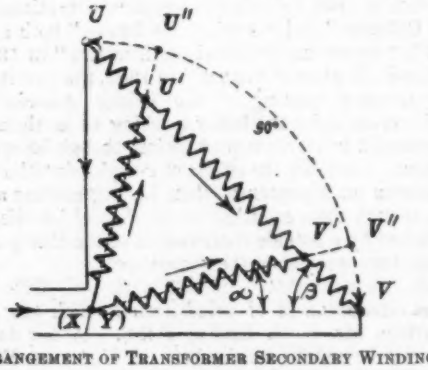
Airdrie and Coatbridge Tramways Order Confirmation Act, 1920.
Dunfermline and District Tramways Order Confirmation Act, 1920.
Tramways Orders Confirmation Act, 1920.
Wrexham District Tramways Act, 1920.
Central London and Metropolitan District Railway Co.'s (Works) Act, 1920.
Hastings Tramways Act, 1920.
Edinburgh Boundaries Extension and Tramways Act, 1920.

Coal Mine Regulations.—The Home Secretary notifies in the *London Gazette* that on July 30th he made general regulations under Sec. 86 of the Coal Mines Act, 1911, to apply to all mines under the Act, and relating to safety precautions and the use of electricity on the surface.

Government Amalgamation of Electrical Enterprises in Japan.—A dispatch from Tokio (Reuter's Trade Service), dated June 13th, says :—"The expansion of electrical enterprises in Japan was one of the most prominent features of the war-trade boom. With the sudden slumps in the financial world, and the refusal of bankers to advance credits, however, many of these schemes have become unworkable, and the Government is now intending to amalgamate all electrical enterprises, thus hoping to stabilise the industry. How greatly the shortage of funds has affected the trade may be seen from the fact that the Nippon Electrical Association and other similar big enterprises have been applying to the Bank of Japan for funds. The Ministry of Communications, which has also been asked to render assistance, is apparently of opinion that the advance of capital to the promoters is a temporary measure, which will not place the industry on a permanent basis. The Government, therefore, issued instructions to Prefectural Governors in June that electrical industries should be amalgamated under the direction of the local authorities, and that power enterprises should be managed on a greater scale than now planned. In the opinion of the Ministry of Communications, this amalgamation of plans and the enlargement of enterprises will not only render the exploitation of water power easier and more economical, but will also make it easier for the promoters to raise capital. The advance of capital asked for is considered of secondary importance by the Government.

Transformation from Two to Three-Phase.—A new method of transforming electrical energy from two-phase to three-phase and *vice versâ* is outlined in the February *Bulletin* of the Schweitzerischer Elektrotechnischer Verein and in the March 7th issue of *Elektrotechnik und Maschinenbau*. The advantage over the Scott method consists in the use of a normal three-phase transformer suitably wound, instead of two single-phase transformers, which leads to a lower initial cost. The new method is also simpler than the arrangements devised by Stern and the Gesellschaft für Elektrische Industrie. It is also shown that the transition from two-phase 40-cycle supply to three-phase 50-cycle supply, which is commonly being carried out in Switzerland and Austria in order to connect existing systems to the long-distance distributing systems, can be effected by very simple re-connections of the transformer windings that can be carried out on the site. The voltages on load are better balanced than in the Scott system. The originator of the system now described is J. Kübler, particulars being given in Swiss Patent No. 82,681.

The accompanying figure shows the arrangement of the secondary



Arrangement of Transformer Secondary Windings.

windings of the transformer, the primary being a normal three-phase winding in star or mesh connection.

One limb of the transformer carries the winding u^1—(x y), the second the winding v^1—(x y), and the third the windings u—u^1, u^1—v^1, and v^1—v. If w_2 is the number of turns on each of the star-connected portions of the secondary winding and w_2^1 the number of turns on each of the portions u—u^1 and v^1—v^2, then $w_2^1/w_2 = \sin\alpha/\sin\beta = \sin 15°/\sin 45°$, and $w_2^1 = (\sqrt{3} - 1)\, w_2/2$. If i_2 is the current per phase on the two-phase side, the sections u—u^1 and v—v^1 carry the current i_2, the sections (x y)—u^1 and (x y)—v^1 carry currents $i_2\sqrt{2}/\sqrt{3}$ displaced 60° from each other in phase, and the section u^1—v^1 carries the current $i_2(\sqrt{3} - 1)/\sqrt{6}$ or approximately 0·3 i_2. The latter section acts as an equalising winding, that renders the symmetrical transformation from three to two-phase possible.

A calculation of the total copper losses shows that if *a* K.V.A. to be transformed from two to three-phase, the three-phase transformer required is one of which the normal rating is 1·07 *a*. The article discusses the 40 to 50 cycle, two to three-phase change referred to above, and shows how it may be carried out, and it appears that after the change the output of the transformer may be increased 30 per cent. for equal heating.

The connection shown in the figure is given for a two-phase system with common third wire, but connection for a two-phase system with four wires may also be obtained by a modification of the arrangement.—*Technical Review.*

Fatalities.—An inquest was held at Redcar last week on Harry Martin, aged 51, a plater's helper, of Middlesbrough, who was killed by an electric shock at the Warrenby steelworks, of Messrs. Dorman, Long & Co., Ltd. It was stated that deceased and a boilersmith were completing repairs to an electric crane. Instead of approaching the electrician, Martin asked a fitter who was working in the driver's cab if the switches were out. All those in the cab were off, and the fitter, thinking that these cut off the power from the whole crane, replied "Yes." Almost immediately Martin collapsed, and his companion received a shock when he went over and touched him. Without their being aware of it, a switch on the top of the crane was on. The power was promptly shut off, but Martin was dead. An electrician was on duty in the portion of the mills where the accident occurred. He was the proper person to approach to ensure safety when work was to be done on the cranes. The Coroner, in returning a verdict of "Accidental Death," said deceased was slightly to blame, he thought, for not having found a responsible man before beginning the work. No doubt Martin took a great deal for granted.

At Beverley, an inquest was held touching the death of Robert Thomas Smith, electrician on the estate of Lieut.-Col. E. W. Stanyforth, J.P., Kirk Hammerton Hall. He was found lying dead beside his motor cycle on the road near South Dalton. It was presumed that he was seized with a fainting fit and fell off his machine, fracturing the base of his skull. Verdict, "Misadventure."

Institution and Lecture Notes.—The Institution of Electrical Engineers.—South Midland Centre.—A Students' Section has been formed in connection with this Centre. Full particulars may be obtained from the Hon. Sec., Mr. J. Wallis Bailey, 14, Carlyle Road, Edgbaston, Birmingham. The first session will open with a meeting on October 12th, and meetings will be held monthly thereafter until April, 1921. The Secretary will be pleased to hear from student members prepared to read papers during the session.

Electric Cooking Ranges: Standard Specification.—There has just been issued by the British Engineering Standards Association a British Standard Specification for Electrically-heated Cooking Ranges (B.S. Specification No. 106—1920). Standard sizes for two cooking ranges are included; the ranges are each in two parts, so that the specification includes two sizes of cooking table and two sizes of oven. These sizes are intended to be suitable for cooking for five persons and ten persons respectively; the cooking table provides hot plates and a grill, with a space to act as a warming chamber. This is the first attempt that has been made to bring about standardisation in this class of appara'us, and in the preparation of the specification the British Electrical and Allied Manufacturers' Association, the Incorporated Municipal Electrical Association, the National Electrical Contractors' Trading Association, and others interested have co-operated. The Sub-Committee of the British Engineering Standards Association responsible for this work was first under the chairmanship of Mr. C. H. Wordingham, C.B.E., and now is under the chairmanship of Mr. S. T. Allen, chief engineer to the Borough of Wolverhampton.

It is hoped that the experience gained by the use of the specification will be forwarded to the B.E.S.A. for the use of the Sub-Committee when the specification comes up for revision next year. The specification is published by the British Engineering Standards Association 28, Victoria Street, where it can be obtained from the secretary (price 1s. 2d. post free).

Educational.—Rutherford Technical College.—In anticipation of the impending changes in the scope and method of conducting examinations for the Postmaster-General's certificate in wireless telegraphy, the Newcastle-upon-Tyne Education Committee has drawn up a revised syllabus for the Department of Wireless Telegraphy at the above College. In the past the classes have not received the support they deserve, probably because it was not generally known that such facilities existed. The Institution is recognised by the Postmaster-General as an examination centre, and periodic examinations are held on the various installations, for which the College is well equipped, and the curriculum extends well beyond the scope of the Postmaster-General's examination.

Electrical Installations in Spain.—It is estimated by an electrical engineer that electrical installations of 250,000 H.P. are in course of construction in Spain. Active investigations are being made in the valley of Aran (Province of Lerida) relative to the possibility of utilising existing falls in that region and forming new ones. The force already in exploitatation is calculated at 600,000 H.P.—*Reuter's Trade Service*, Madrid.

Fire.—Many thousands of pounds' worth of damage was done by a fire which broke out on Saturday afternoon in the dynamo-house attached to the joiners' shop at the shipbuilding yard of Messrs. Hawthorn, Leslie & Co., Ltd., Hebburn-on-Tyne.

Electrically-treated Milk. — The Medical Research Committee has published a report on the destruction of bacteria in milk by means of electricity. This method was introduced at Liverpool in 1911.* The present account is by Prof. J. M. Beattie, of Liverpool, and Mr. F. C. Lewis, Lecturer of Bacteriological Methods, University of Liverpool. An independent trial of the method was also made at Birmingham, where Prof. R. F. C. Leith repeated and extended the Liverpool observations. Sir Oliver Lodge superintended the study of the electrical action on its technical side, and Prof. Beattie put apparatus at Dr. Leith's disposal. The results of both experiments agree, says the *Times*, in supporting the value of the electrical method of sterilisation. The Birmingham workers found that the electrical method showed a close parallelism to the old method of sterilisation by heat, and are inclined to think that the current does its work of killing the bacteria by virtue of the heat which it generates. They were led to believe that in the electrical method the current raises the temperature of the milk more quickly, and since it passes through every part of the milk, the heat which it generates reaches every part of the milk at the same moment. It has this advantage over the simpler thermal method. Further, though the heat is generated always at the same rate, it increases with the length of the milk column traversed by the electrical current, and hence, as in the thermal method, the temperature of the milk will continue to increase until it reaches its highest point as it issues from the tube. The heat conditions of the two methods are, therefore, very similar. Their sterilising power is also similar, though the electrical is quicker in its action, and Prof. Leith summarised his report by saying that "both the thermal and electrical methods have a high practical value, and deserve consideration in any endeavour made to improve milk supplies. The thermal is simpler and cheaper, the electrical quicker in action." Prof. Leith suggested further that both methods could be made more efficient by adopting the practice of pasteurising by two treatment applications, with rapid cooling of the milk after each, and that even with a single application the milk would store better if rapidly cooled after treatment. In the opinion of the Medical Research Committee the experiments at Birmingham, though they entirely support the practical results obtained by Prof. Beattie and Mr. Lewis at Liverpool, were not complete enough on their bacteriological side to settle finally the question whether the electrical current in this method has a direct bactericidal action or whether it acts purely as a thermal agent. Sir Oliver Lodge was strongly of opinion that its action was purely thermal.

According to the *Manchester Guardian* the conclusions of the investigators are that this electrical treatment is much more effective in ridding milk of bacteria than are processes at present in general use. The results are regular, and the risks of after-contamination are comparatively small, if the rules of ordinary cleanliness are observed. The milk, especially if rapidly cooled, can be kept for several days at ordinary room temperature without any apparent change. The use of refrigerating plant is recommended as a necessary adjunct to the electrical apparatus in large-scale practice, in order to ensure rapid cooling and so improve the "keeping quality."

The *Lancet* concludes that milk can now be rendered free from *B. coli* and *B. tuberculosis* by the electrical method described, without raising the temperature higher than 63 deg. or 64 deg. C. The temperature effect is very short in duration, and in itself is not the principal factor in the destruction of the bacteria. It is stated that though the milk is not sterilised in the strict sense of the word, yet the percentage reduction of the bacteria, taken over a period of a fortnight, is 99.93. The keeping power of the milk appears to be increased, the taste is not altered, and, so far as careful chemical examination can determine, the properties not impaired. Finally, it is definitely stated that the milk so treated can be described accurately as raw milk free from pathogenetic bacteria. No very extensive work has been done nor safe conclusions deduced about the biological value of the milk so treated, but so far babies fed on the milk are reported to have done "extremely well."

Electric Rolling Mills. — A valuable paper on the "Power Requirements of Rolling Mills" was recently read before the South African Institute of Electrical Engineers by the President, Mr. A. du Pasquier, M.I.E.E. The paper is unsuitable for brief abstraction, but the author's concluding remarks are of considerable interest. He says: "This (the saving of fuel) is, of course, not the only benefit, in addition to the general advantages with regard to space, cleanliness, lower upkeep, more regular speed, and consequently better output that are inherent to electrification, in rolling mills and particularly reversing mills, the perfect speed control afforded by the Ward-Leonard system is a most important factor in the output of a large mill. Electrically-driven mills of 10,000 to 15,000 H.P. are capable of being reversed 20 to 25 times a minute, with a full-load speed of 60 R.P.M. This is far beyond the possibilities of a steam engine, and indeed beyond the actual requirements of the mill, but the ability to reverse in so small an interval of time is an index to the general speed control available. An ingot leaves the rolls at the velocity of the rolls, and for economy in time the speed of the roll must be so decelerated before the pass is completed that the ingot is delivered and its progress arrested close up against the roll ready for the next pass. When one considers that the time element of the earlier passes is only a matter of a second or less, the capacity for rapid reversal is a very valuable feature."

* Elec. Rev., February 20th, p. 317; April 24th, p. 712; May 8th, p. 790; and July 31st, p. 169, 1914.

Appointments Vacant. — Power-house superintendent (£523), for the Borough of Stoke-on-Trent Electrical Engineer's Department; switchboard attendant (43s. 6d. + 33s. 6d. + 12½ per cent.), for the Lancaster Corporation Electricity Department; installation and meter foreman (115s.), for the County Borough of Salford Electricity Department; temporary engineer in connection with hydro-electric surveys in Bombay and Burma (Rs. 675 to Rs. 1,175 per mensem, according to age), for the Public Works Department, India; teachers of electrical wiremen's work and electricity and magnetism, for the Guildford Technical Institute; sub-station engineer (£500), for the Durban Corporation Electricity Department; two switchboard attendants (90s. 9d.), and one electrical fitter (94s.), for the Southend Corporation Electricity Department; mains engineer (£300), for the Colne Borough Council Electricity and Tramways Department; assistant divisional engineer for the Government of Straits Settlements telegraphs and telephones (360 dollars per month + 20 per cent. Dollar = 2s. 4d.) See our advertisement pages to-day.

Legal.—Electric Light Company Fined.—The Winscombe Electric Light and Power Co. was recently fined £5 for an offence under the Factory Act, by not having the flywheel of a gas-engine securely fenced.

Electrician Charged.—At Hull last week, George Knight, chief electrician of the British Oil and Cake Mills, was remanded for seven days on a charge of stealing a dynamo. Mr. W. J. Stuart opposed bail, and said property of the value of from £800 to £2,000 might be involved. Prisoner had threatened to leave the country. Bail was refused.—*Yorkshire Herald.*

French Hydro-electric Power.—The Paris correspondent of the *Financial Times* says that according to recent estimates France possesses—mostly in an inert and unutilised condition—the greatest hydraulic power of any country in Europe. Though engineers and others frequently drew attention to the hydraulic possibilities of France, it required the great war and the destruction of the chief French collieries by the Germans to bring these possibilities to official notice. Officialdom in France is an exceedingly slow mover, and it takes ages for any new scheme to crystallise in its mind. The coal shortage at least has had the advantage of bringing the hydraulic question to the front, and the Under-Secretary of State for Hydraulic Power has now elaborated a definite scheme for the electrification of a large portion of the railways of France. These railroads have been under direct Government management, but the direction has now been restored to the companies. In any case, the permanent ways are the property of the State, and are only held on lease by the companies. It is this fact that enables such a vast question to be taken up and decided by the State as a central railway authority.

In a recent interview, Mr. G. Tochon, the Chief of Staff to the Under-Secretary of State, said:—"The special Railway Commissions which have been engaged in studying the matter for over two years, estimate that the total cost of electrification of the Orleans system will amount to 760 millions of francs (nominally £30,400,000), for the Paris, Lyons, and Mediterranean lines 1,190 millions of francs (nominally £47,600,000), and for the Midi, or Southern Co.'s system, 740 millions of francs (nominally £29,600,000). Thus the three railway systems, covering about 8,000 kilometres, or 4,800 miles, can—according to these estimates—be electrified for a total outlay of £107,600,000.

"In 1913 the Orleans Co. utilised for train haulage 450,000 tons of coal, the Paris, Lyons, and Mediterranean Co. between 650,000 and 700,000 tons, and the Midi Co. 370,000 tons. This is far below our present requirements, but even taking the figures for 1913, we shall, by the electrification from hydraulic power of our railways, save, in 20 years' time, a minimum of 3,000,000 tons of coal per annum. At the present prices of coal this implies a saving of £7,200,000 per annum."

Wireless in the Fishing Industry.—Quite a number of the North Sea trawlers, and many of the little steam-drifters as well, have been fitted with wireless telegraphy. Their sending radius is small, but they can receive messages from long distances. According to the *Evening News*, the real purpose of the installations is receiving; and most of the messages sent concern the state of the fish market. When the market is glutted, and the price of fish right down, they are instructed to stay out and go on fishing for another day or two. Similarly, when railway congestion forces dealers to sell fish as manure, the fishing hauls can be diverted to other ports more fortunately situated.

The Late Prof. Perry. — The Institution of Electrical Engineers was represented at the funeral of Prof. John Perry, F.R.S., Past President, at Wendover Churchyard, by Mr. Roger T. Smith, President, Mr. L. B. Atkinson, President-elect, Dr. W. H. Eccles, Vice-President, and at the Memorial Service at St. Peter's Church, Bayswater, by Mr. A. Siemens, Mr. W. M. Mordey, Past Presidents, Sir James Devonshire, Honorary Treasurer, and Mr. R. H. Tree, Chief Clerk.

A New A.C. Mercury Arc.—It is common knowledge that under ordinary conditions an A.C. arc is not maintained between metallic electrodes. Aarons has shown in fact that interruption of continuous current flowing through an arc between mercury electrodes for so short a period as 1/100,000 sec. is sufficient to extinguish the arc. The 3-electrode mercury lamp (in which one electrode is connected to the central point of an auto-transformer, the terminals of which are connected to the other two electrodes), is not an A.C. arc because each half of the lamp is traversed by a current always in the same sense. On the other hand, research with mercury rectifiers has shown that an A.C. arc is possible between mercury electrodes provided that: (1) The electrodes are already hot. (2) The voltage exceeds 600 volts. (3) The circuit has considerable self-induction. (4) The pressure of the mercury vapour exceeds 1 cm.

M. Henri Georges found that an A.C. arc could be maintained between mercury electrodes which were not pre-heated by using about 400 volts, and striking the arc by breaking a thread of mercury connecting the electrodes in an atmosphere of neon at a pressure of about 20 cm., and he now describes (in a recent note to the Académie des Sciences), a 2-electrode lamp based on a different principle. The new lamp starts with cold electrodes, and operates at voltages exceeding 500 volts; it has a quartz tube, and develops a vapour pressure exceeding 2 kg. per sq. cm. Reservoirs at the ends of the quartz tube contain an extremely small quantity of mercury (1 cc. for a 2-KW. lamp), and the lamp contains a rare gas (preferably neon) at a pressure, when cold, exceeding 1 cm. of mercury. The lamp is connected to the secondary terminals of a transformer containing self-induction in the primary, or a leakage transformer (*transformateur à fuites*) may be used, the lamp being then started merely by closing the primary circuit.

It takes about 7 mins. before the lamp reaches its steady operating conditions, and the several stages of starting can be distinguished easily, but are quite stable. The successive stages are as follows: (1) Luminescence of the inert gas, the spectrum emitted being that of the gas and the terminal voltage being about 2 volts per cm. This stage lasts only for a fraction of 1 sec., the mercury being rapidly vaporised. (2) As the mercury evaporates, the pressure falls to 0.5 volt per cm. of arc, and there is luminescence of the mixture of inert gas and mercury vapour. During the next few seconds the inert gas is driven into the bulbs at the ends of the tube, where it assists in condensing the mercury. The light emitted is then that of the low-pressure mercury arc. (3) From this moment, as the quantity of mercury is very small, the vapour pressure rises rapidly (this being a condition of stability), and the voltage increases simultaneously to about 50 volts per cm. The arc becomes a fine thread of high brilliancy, and the temperature of the walls of the lamp rises to 700 deg. C. This steady, high pressure arc is obtained about 7 minutes after lighting the lamp.

For satisfactory operation it is essential that the lamp be dimensioned very accurately, so that the vapour pressure rises very quickly at the start, otherwise the arc becomes unstable and goes out. Similarly, the cooling must be such that stable operation is maintained indefinitely.

The first pattern of the new lamp has a tube 40 cm. long and consumes 2 KW. in the arc when running steadily. The lamp is supplied by a 110/3,000-volt transformer, and takes 1 amp. at a terminal p.d. of 2,250 volts, corresponding to a power factor of 0.7. Smaller lamps can be made for laboratory use, but the principal interest of the new type lies in the possibility of building very powerful units. Lamps of 10 KW. or over are considered to be practicable, and these would be more powerful than any other source of ultra-violet light yet available.

Thermo-Electricity.—In a recent lecture before the Institute of Metals, Prof. C. A. F. Benedicks shortly summarised his theoretical views upon the metallic conduction of electricity which explained many matters not made clear by the former electron theory.

According to the *Technical Review* a consequence of this new theory is that one has to conclude that, even in a single homogeneous metal, thermo-electric currents do occur; hitherto such currents were believed to be produced only when two different metals were present. Prof. Benedicks gave a concise demonstration of the most important experimental evidence of the truth of this conclusion, utilising for the purpose various metals. In liquid mercury it had been possible for him definitely to prove the existence of thermo-electric currents, thus disproving the negative results of previous workers. A consequence of what the lecturer termed his "homogeneous thermo-electric effect" was that there must exist the reverse effect, the "homogeneous electro-thermic effect," including as a special case the well-known Thomson effect. The reality of this effect was duly made clear. An interesting demonstration was given of a new rotating thermo-electric apparatus made entirely of copper and rotating in a magnetic field, the driving force originating solely from unequal heating (by means of a tiny gas jet) of thin strips of copper. The point at which the new knowledge brought forward by Prof. Benedicks might have some practical interest lay in the possibility of reducng the thermal conductivity of metals by insulated sub-division into fine wires without impairing the electrical conductivity.

Oil Fuel and Railway Electrification.—The increasing cost and scarcity of fuel are hastening the development of electric traction on the Pacific Coast of the U.S.A. In a paper before the recent N.E.L.A. Convention, U.S.A., Mr. J. E. Woodbridge states, according to the *Technical Review*, that since May, 1915, crude oil stocks in California have decreased from over 60,000,000 bbl. to less than 29,000,000 bbl. in March, 1920. The available supply of crude oil in stock to-day is less than 13,000,000 bbl., and at the present rate of consumption and production the available stocks will be exhausted in about 12 months. The Standard Oil Co., of California, is installing new processes by which it is estimated that more refined products, including gasoline, will be recovered from crude oil in such quantities that the company's production of fuel oil will be reduced about 30 per cent. within a year. In an ordinary steam station developing from 185 to 200 KW.-hours per barrel the cost for fuel alone will be at least 1 per cent. per KW.-hour, and this figure, added to other steam operating costs and fixed charges, will make the total cost of steam power much higher than that of hydro-electric power. This being the case for steam turbine plant it is much more true for steam locomotives, so that, apart from all other reasons, the cost of fuel will compel steam railways to be electrified on a wholesale basis. Under present conditions central station companies cannot meet their ordinary commercial demands, and the outlay involved by a comprehensive railroad electrification supply can only be met by power rates under which the railways themselves will make a suitable contribution.

With regard to this country there is the question of how far a coal strike would aid in the development of oil as a substitute fuel. Last year's railway strike emphasised the menace of road transport to the railways, and there are Government officials who, according to the daily Press, hold the belief that a coal strike would serve the same purpose in relation to oil. Further, it is stated that certain Government departments are considering how far it may be possible to rely upon oil for fuel and electricity for internal heating in the event of a strike.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

The Liverpool Corporation Tramways Committee has recommended the following increases of salary to officers of the department: Mr. P. PRIESTLEY, general manager, £250 (total salary and bonus £1,650); Mr. C. G. JACKSON, assistant general manager, £100 (making a total of £850); Mr. H. I. PALMER, general traffic assistant, £100 (£650); Mr. J. WOOD, chief clerk in traffic office, £100 (£600); Mr. E. R. MYERS, overhead lines superintendent, £100 (£600); Mr. C. BIRCHALL, £65 (£365).

Torquay T.C. has granted the following increases of salary: Mr. G. B. DENT, station superintendent, from £250 to £310; mains engineer, Mr. A. J. WARING, from £250 to £300; draughtsman, Mr. J. B. NECK, from £3 to £3 10s. per week; charge engineers, from £220 to £250.

Mr. H. E. CORDELL, works manager's assistant, L. & Y. Railway carriage works, Newton Heath, has been appointed superintendent at the Manchester Corporation Hyde Road tramcar works, at a salary of £500 per annum, plus Civil Service bonus.

At a largely attended meeting of the electrical contractors of Dublin, a presentation was made to Mr. F. W. PARKES on the occasion of his leaving the Edison Swan Co. to commence business on his own account. Mr. A. G. Bruty, chairman of the Contractors' Association, handed to Mr. Parkes a cheque and an address. Mr. Parkes appropriately replied.

There were 129 applicants for the post of electrical engineer at Wrexham, and four gentlemen were selected for further consideration by the Electricity Committee.

Mr. R. FERGUSON, northern manager of Messrs. Hays, Hunter & Standen, Ltd., is joining the Mycromet Manufacturing Co., of Oldham, who have equipped their works for the manufacture of electrical accessories.

Mr. G. F. A. NORMAN, director of Tredegars, Ltd., and Mr. RABBETTS, supervising engineer, have severed their connection with that firm, having joined the firm of F. G. Minter, contractor, of 10, Davies Street, Berkeley Square, W., where catalogues and prices of electrical goods are wanted.

Rotherham T.C. is recommended to increase the salary of the tramways manager, Mr. T. P. SYKES, from £500 to £700 a year, rising by two yearly increments to £900, and that of the traffic superintendent (Mr. W. G. MARKS) from £324 to £380.

Southampton T.C. has increased the salary of the tramway manager and engineer, Mr. DOBSON, from £700 to £900 a year, rising by two annual increments to £1,000.

Mr. James A. Wishart, Burgh electrical engineer, Motherwell, has tendered his resignation to the Motherwell Town Council in order to take up an appointment in Western Canada with a private concern. Mr. Wishart has been in Motherwell for the last ten years, and for the last nine years as Burgh electrical engineer.

Obituary.—Mr. S. H. Sands.—The death occurred, suddenly, last week, at the age of 87 years, of Mr. Samuel Herrick Sands, an ex-mayor of Nottingham, and formerly a prominent director of the National Telephone Co., Ltd.

Mr. R. T. Smith.—The death occurred on Bank Holiday, through an accident whilst motor cycling, of Mr. Robert Thomas Smith, electrical engineer, who was in business at Kirk Hammerton, near York. He was 43 years of age, and was estate electrician to Lieut.-Col. E. W. Stanyforth, J.P., Kirk Hammerton Hall.

NEW COMPANIES REGISTERED.

Central Electrical Engineering Co., Ltd. (169,436).—Private company. Registered August 4th. Capital, £500 in £1 shares. To acquire the business carried on at 26, Paradise Square, Sheffield, as the Central Electrical Engineering Co., and to carry on the business of electrical and mechanical engineers in its branches. The subscribers are: J. H. Horner, 26, Paradise Square, Sheffield, electrical engineer; Mrs. B. Horner, 26, Paradise Square, Sheffield. J. H. Horner is sole director. Registered office: 20, Paradise Square, Sheffield.

Bath Tramways Motor Co., Ltd. (169,379).—Registered July 30th. Capital, £60,000 in £1 shares. To adopt an agreement with Bath Electric Tramways, Ltd., for the acquisition of the company's undertaking so far as concerns the company's foundry at Walcot Street, Bath, and its services of motor omnibuses and other motor vehicles and certain assets connected therewith. The first directors are: J. B. Hamilton, Kenston, Kirkstall, Leeds; H. F. Chutterbuck, Dicketts, Corsham, Wilts.; A. A. C. Swinton, 66, Victoria Street, Westminster; E. H. R. Trenow, Balfour House, 125, Finsbury Pavement, E.C.; W. E. Hardy, York Villa, Kensington, Bath. Directors' borrowing powers restricted to £100,000. Qualification, £150. Remuneration, £50 each per annum (chairman £100). Registered office: Balfour House, 125, Finsbury Pavement, E.C.

Society of Radiographers (Word "Limited" omitted from the title by licence of the Board of Trade). (169,483).—Registered August 6th, as a company limited by guarantee. To promote the science and regulate the practice of radiography. The first directors are: Dr. F. Herman-Johnson, M.B., 87-89, Mortimer Street, W.1, medical practitioner; Dr. R. Knox, M.B., 38, Harley Street, W., medical practitioner; Dr. S. Melville, L.S.A., 9, Chandos Street, W., medical practitioner; Dr. G. H. Orton, M.A., 67, Upper Berkeley Street, W., medical practitioner; Sir Archibald Reid, K.B.E., C.M.G., 90, Welbeck Street, W., medical practitioner; Prof. S. Russ, 19, Northumberland Mansions, Northumberland Street, W., medical practitioner; Dr. W. H. Eccles, 2, Ryder Street, W., professor, Finsbury Technical College; J. S. Highfield, 19, Cottesmore Gardens, Kensington, W.8, consulting engineer; C. C. Paterson, O.B.E., 10, Walpole Gardens, Strawberry Hill, Twickenham, electrical engineer; A. A. Campbell Swinton, F.R.S., 66, Victoria Street, S.W., electrical engineer; Dr. R. M. Walmsley, F.R.S.E., 23, Hilldrop Road, N.7, Principal, Northampton Polytechnic Institute; C. H. Wordingham, C.B., Beechgrove, Ridgeway Road, Redhill, consulting engineer; R. G. G. Blackall, Romany Villa, Endway, S. Benfleet, radiologist; C. O. Forder, 55, Playfield Crescent, E. Dulwich, radiologist; H. Henry, Queen Alexandra Military Hospital, Millbank, radiologist; H. Turner, Middlesex Hospital, W.C., radiologist; G. F. Westlake, 93, Clarendon Road, Putney, S.W., radiologist; F. E. Doran, 46, Carill Drive, Fallowfield, Manchester, radiologist. Solicitor: O. W. Bristow, 1, Copthall Buildings, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

G. Weston & Sons, Ltd.—Satisfaction in full on June 11th, 1920, of debentures dated October 17th, 1913, securing £2,000.

Barraclough Brothers, Ltd.—H. S. Dickinson, of Brighouse, Yorks., as receiver or manager on July 27th, 1920, under powers contained in debentures dated November 14th, 1915.

Auckland Electric Tramway Co., Ltd.—Trust deed dated March 29th, 1920 (supplemental to trust deed dated July 14th, 1903), to secure £374,088 debenture stock outstanding. Charged on £500,000 debentures issued by the Corporation of City of Auckland, N.Z., in substitution for property, charged by original deed and all residue and remainder of purchase moneys payable to the company by the Corporation, and company's undertaking, and other assets, present and future. Trustees: Electric and General Investment Co., Ltd.

West London & Provincial Electric Supply Co., Ltd. (62,097).—Return dated May 26th, 1920. Capital, £150,000 in £1 shares (80,000 6 per cent. cumulative preference and 70,000 ordinary), 23,354 ordinary and 49,077 preferred taken up, £57,431 paid, £15,000 considered as paid. Mortgages and charges, Nil.

Aluminium Corporation, Ltd.—Issue on July 27th, 1920, of £10,000 debentures, part of a series, already registered.

Bankfoot Power Co., Ltd.—Satisfaction to the extent of £5,000 on September 30th, 1919, of debentures dated July 28th, 1911, securing £10,000.

CITY NOTES.

County of London Electric Supply Co., Ltd.—Interim dividends on the preference shares at the rate of 6 per cent. per annum, less tax, and on the ordinary shares at the rate of 5 per cent. per annum, less tax, for the half-year ended June.

Clyde Valley Electrical Power Co.—Interim dividend of 2½ per cent. actual, less tax.

Stock Exchange Notices.—The Committee has ordered the following to be officially quoted:—

General Electric Co., Ltd.—808,334 ordinary shares of £1 each, fully paid, Nos. 1,225,001 to 2,033,334.

Morgan Crucible Co., Ltd.—£400,000 6 per cent. first mortgage redeemable debentures (registered), within Nos. 1 to 5,000 (£100), in lieu of the scrip.

Ruston & Hornsby, Ltd.—818,568 ordinary shares of £1 each, fully paid, Nos. 1,231,433 to 2,050,000.

Prospectuses.—*Bath Tramways Motor Co., Ltd.*—This company is offering 30,000 shares of £1 each at par, holders of shares in Bath Electric Tramways, Ltd., receiving preference in allotment. The company will acquire from the latter company and maintain and develop the motor omnibus and motor vehicle undertaking of that company.

Telephone Manufacturing Co., Ltd.—Letters of allotment have been posted.

Bullers, Ltd.—Letters of acceptance in connection with the recent issue of debentures have been posted.

Vera Cruz Electric Light, Power & Traction Co., Ltd.—Dividend of 5 per cent. for the half year, making 10 per cent. for the year. £15,000 to depreciation and reserve, and £23,398 carried forward.

Brompton & Kensington Electricity Supply Co., Ltd.—Interim dividend on the ordinary shares at the rate of 9 per cent. per annum, less tax for the half-year.

Tottenham District Light, Heat & Power Co., Ltd.—Interim dividend of 3½ per cent. per annum on "A" stock and 2½ per cent. per annum, less tax, on "B" stock for half-year.

Mansfield & District Tramways Co., Ltd.—Interim dividend of 3 per cent., less tax, on the ordinary shares for the half-year.

STOCKS AND SHARES.

Tuesday Evening.

Stock Exchange markets remain in a very subdued condition, owing to the Russian-Polish position. The announcement made by Mr. Lloyd George in the House of Commons on Tuesday was not known during business hours, but the advance intimations as to its purport served to check any severe fall which might have occurred at the prospect of the Allies being dragged into a fresh war. Investment stocks kept steady, owing to the general impression that neither this country nor France would enter upon active hostilities for the sake of Poland, although it was recognised that assistance might be afforded in other ways. The War Loan, and other such securities which are regarded at all times of crises as being the bellwethers of the Stock Exchange, held their ground, and this firmness was quoted as evidence of the investor's refusal to be scared by the Polish situation, and also by the possibility of dearer money.

It may be that the Bank Rate will have risen before this issue appears, for Lombard Street is fidgetty about the money outlook, and if the Rate remains at 7 per cent. this week, the expectation is that it will be put up to 8 per cent. before the end of August.

The heavy fall in New York exchange adds another factor of disturbance, though, of course, it is regarded without disfavour by those investors in this country who held dollar stocks—such, for instance, as those of the American and Canadian utility companies whose bonds carry coupons payable in dollars as well as sterling. The Commercial Cable Company is offering to buy, from the proprietors of the 4 per cent. debenture stock, their holdings at 80 per cent. This is an excellent price, and the money can be used to better advantage in other directions, so that the holders of the stock will be well advised to accept the price offered.

Home Railways continue in doleful case. If prices go up ½, they slip back twice as much, and while the Undergrounds are not much affected by the general malaise in the market, they are precluded from improvement, owing to the weakness of the steam stocks. That Underground Electrics, Districts and Metropolitans should keep as steady as they are doing in the face of flatness amongst the rest, is a point in their favour which infers the promise of better things, if and when the Home Railway market does settle down to firmer conditions.

The British Columbia Electric Railway Company has declared dividends of 3½ per cent., free of tax, on its preferred and deferred stocks in respect of the year ended June 30th last. The manner of declaration arouses some little surprise, because the preferred is a 5 per cent. stock, and it is asked in the Stock Exchange why the company should not have declared the dividend at 5 per cent. gross instead of 3½ per cent. net. The result, of course, is the same, but it would be interesting to know the reasons that led to the unusual step. Argentine Tramways second preference at 3½ have come into line with the company's first preference shares. Mexico

Tramways 6 per cent. bonds are 2 up and Mexican Light first bonds at 50 are a point to the good. There is nothing doing in Brazil Tractions, and other foreign issues are very quiet.

The Brompton & Kensington Electric Lighting Company has declared an interim dividend at the rate of 9 per cent. on its ordinary shares, the price of which remains at 6¾. Charing Cross ordinary at 3¾ are ¼ lower, and this is the only alteration in the lighting list. Some of the manufacturing shares are easier. General Electric ordinary at 28s. are a florin down. British Aluminiums went back to 20s. Metropolitan-Vickers preference at 2¾ are 1-16 lower, and the ordinary have fallen back to 1¼, the 4 per cent. debenture stock at 55¼ also being easier. Electric Constructions are 1-16 lower, and the 4 per cent. debenture at 57¼ is 2 points lower. It is said that an issue of Pirelli 7½ per cent. three-year notes is to be made at 95 under the auspices of the General Electric Company. Dealings are expected to begin this week in the lately-issued Fuller's United debenture and in Brush new shares. The Calcutta Electric convertible debenture, issued at 95, is a firm market at 1¼ discount.

Cable stocks press quietly upwards. Eastern ordinary has regained the round 150, and "China" shares are 5s. better at 14¾. The Marconi group is heavy, and the parent shares have been down to a little under 55s. Marines are 33s. 9d. United River Plate Telephones at 6¾ have again lost an eighth.

The rubber share market is placid and uninteresting. Business is on a meagre scale. The price of the raw product remains dull. Armaments are not a good market, Armstrongs falling to 26s., with Vickers remaining in the neighbourhood of 24s. 3d.; the Vickers new Notes, however, hardening to 1¼ premium. Babcock & Wilcox at 50s. are unchanged.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Aug. 10, 1920.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	8	12	6¾	—	£3 8 2
Charing Cross Ordinary	4	7	3¾	— ¼	10 7 4
do. do. do 4½ Pref.	4½	4½	2¾	—	8 3 8
Chelsea	3	4	2½	—	8 0 0
City of London	8	10	1¼	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 2
County of London	7	8	8	—	10 0 0
do do. 6 per cent. Pref.	6	6	8½	—	7 5 5
Kensington Ordinary	6	7	4	—	8 15 0
London Electric	Nil	2½	1¼	—	6 0 0
do. do. 6 per cent. Pref.	6	6	8	—	10 0 0
Metropolitan	5	6	2¾	—	10 8 8
do. 4½ per cent. Pref.	4½	4½	2½	—	8 0 0
St. James' and Pall Mall	10	12	6⅝	—	9 1 2
South London	5	6	2¾	—	9 12 0
South Metropolitan Pref.	7	7	18/9	—	7 0 0
Westminster Ordinary	8	10	5¼	—	9 15 2
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	79½	—	7 11 0
do. Def.	33/6	1½	17½	—	8 11 5
Chile Telephone	8	6	6	—	*5 0 0
Cuba Sub. Ord.	7	7	8¼	—	*8 4 8
Eastern Extension	8	10	14⅞	+ ¼	*6 15 7
Eastern Tel. Ord.	8	10	150	+2½	*6 13 4
Globe Tel. and T. Ord.	8	10	15	—	*6 13 4
do. do. Pref.	6	6	8½	—	7 1 2
Great Northern Tel.	22	22	21¼	—	10 4 8
Indo-European	13	10	30	—	8 6 8
Marconi	25	25	2⅞	— 1/16	9 1 10
Oriental Telephone Ord.	10	12	2½	—	*4 16 0
United R. Plate Tel.	8	8	6¾	— ¼	*5 18 6
West India and Panama	1/3	Nil	1/16	—	Nil
Western Telegraph	8	10	15	—	*6 13 4
Home Rails.					
Central London Ord. Assented	4	4	44½	—	8 19 9
Metropolitan	1	1½	19½xd	—	6 8 2
do. District	Nil	Nil	15	—	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	—	Nil
do. do. "A"	Nil	Nil	5/6	—	Nil
do. do. Income	5	4	57½	—	—
Foreign Trams, &c.					
Anglo-Arg. Trams. First Pref.	Nil	5½	3½	—	8 9 2
do. do. 2nd Pref.	Nil	Nil	8¾	— ¼	Nil
do. do. 5 Deb.	5	5	58⅜	—	8 11 0
Brazil Tractions	Nil	Nil	4⅜	—	Nil
Bombay Electric Pref.	6	6	13	—	4 10 0
British Columbia Elec. Rly. Pfcs.	5	5	54½	- 2	9 3 6
do. do. Preferrred	5½	5	52½	—	*6 13 4
do. do. Deferred	Nil	3	53½	—	*6 13 4
do. do. Deb.	4½	4½	55	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	30	—	Nil
do. 6 per cent. Bonds	Nil	Nil	31	+2	Nil
Mexican Light Common	Nil	Nil	14	—	Nil
do. Pref.	Nil	Nil	25½	—	Nil
do. 1st Bonds	Nil	Nil	50	+1	Nil
Manufacturing Companies.					
Babcock & Wilcox	15	15	2½	—	*5 0 0
British Aluminium Ord.	10	10	1	— 1/16	10 0 0
British Insulated Ord.	12½	15	13⅜	—	8 5 6
Callenders	25	15	1 1/16	—	11 8 6
,, 6½ Pref.	6½	6½	18/-	—	7 4 5
Castner-Kellner	20	17	3	—	5 13 4
Crompton Ord.	10	10	19/6	—	10 5 2
Edison-Swan, "A"	10	10	1¼	—	8 17 10
do. do. 5 per cent. Deb.	5	5	78½	—	6 5 9
Electric Construction	10	10	1 1/16	— 1/16	10 13 4
Gen. Elec. Pref.	6¾	6¾	18/6	—	7 6 5
do. Ord.	10	10	23/-	—2/-	*7 2 10
Henley	25	15	1¼	—	8 0 0
do. 4½ Pref.	4½	4½	8¼	—	6 18 6
India-Rubber	10	10	25/9	—	*7 15 4
Met.-Vickers Pref.	—	8	2½	— 1/16	7 6 2
Siemens Ord.	10	10	26/-	—6d.	*8 0 0
Telegraph Con.	20	20	20½	—	*5 17 0

* Dividends paid free of Income Tax.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Tuesday, August 10th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	2/5	1d. inc.
a Ammoniac Sal	per ton	£100	...
a Ammonia, Muriate (large crystal)	,,	£92	...
a Bisulphide of Carbon	,,	...	...
a Borax	,,	£50	...
a Copper Sulphate	,,	£44	...
a Potash, Chlorate	per lb.	1/-	...
a ,, Perchlorate	,,	1/3	...
a Shellac	per cwt.	£94	...
a Sulphate of Magnesia	per ton	£18	...
a Sulphur, Sublimed Flowers	,,	£28	...
a ,, Lump	,,	£25	...
a Soda, Chlorate	per lb.	6d.	...
a ,, Crystals	per ton	£12	...
a Sodium Bichromate, casks	per lb.	...	...
METALS, &c.			
g Babbitt's Metal Ingots	per ton	£118 to £345	...
c Brass (rolled metal 2" to 12" basis)	per lb.	1/3½	½d. inc.
c ,, Tubes (solid drawn)	,,	1/6½ to 1/6½	½d. inc.
c ,, Wire, basis	,,	1/3½	½d. inc.
c Copper Tubes (solid drawn)	,,	1/9	½d. inc.
g ,, Bars (best selected)	per ton	£166	£2 inc.
g ,, Sheet	,,	£166	£2 inc.
g ,, Rod	,,	£166	£4 inc.
d ,, (Electrolytic) Bars	,,	£117	£3 inc.
d ,, ,, Sheets	,,	£159	£3 inc.
d ,, ,, Wire Rods	,,	£133	£3 inc.
d ,, ,, H.C. Wire	per lb.	1/4½	½d. inc.
f Ebonite Rod	,,	3/-	...
f ,, Sheet	,,	2/6	...
n German Silver Wire	,,	3/-	...
h Gutta-percha, fine	,,	14/-	...
h India-rubber, Para fine	,,	1/9½	½d. inc.
i Iron Pig (Cleveland Warrants)	per ton	Nom.	...
l ,, Wire, galv. No. 8, P.O. qual.	,,	£29	...
g Lead, English Pig	,,	£40	30/- inc.
g Mercury	per bot.	£20 10s. to £21	...
e Mica (in original cases) small	per lb.	6d. to 4/6	...
e ,, ,, ,, medium	,,	5/- to 10/-	...
g ,, ,, ,, large	,,	12/6 to 25/- & up	...
g Phosphor Bronze, plain castings	,,	1/6 to 1/11	...
g ,, ,, rolled bars and rods	,,	2/2 to 2/6	...
d ,, ,, rolled strip & sheet	,,	2/3 to 2/9	...
r Silicium Bronze Wire	per lb.	1/11½	...
g Steel, Magnet, in bars	,,	1/8	...
n Tin, Block (English)	per ton	£276 to £277	£10 inc.
e ,, Wire, Nos. 1 to 16	per lb.	4/9	...
White Anti-friction Metals	per ton	£80 to £235	...

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons,
r W. F. Dennis & Co.

Research in Wireless Communication.—The Department of Scientific and Industrial Research has now established four sub-committees to assist the Radio Research Board in the investigation of certain problems in connection with the work of the Board. The constitution of the Board and its sub-committees is at present as follows:—

Radio Research Board.—Admiral of the Fleet, Sir Henry B. Jackson, G.C.B., K.C.V.O., F.R.S. (chairman); Commander J. S. C. Salmond, R.N. (representing the Admiralty); Lieut.-Col. A. G. T. Cusins, C.M.G., R.E. (representing the War Office); Wing Commander A. D. W. Morris, C.M.G., O.B.E. (representing the Air Ministry); Mr. E. H. Shaughnessy, O.B.E. (representing the General Post Office); Prof. Sir J. E. Petavel, K.B.E., F.R.S. (representing the National Physical Laboratory); Prof. Sir Ernest Rutherford, F.R.S.; Prof. J. S. E. Townsend, F.R.S.

Sub-Committee A on the Propagation of Wireless Waves.—Dr. E. H. Rayner, Sc.D. (chairman); Prof. E. H. Barton, D.Sc., F.R.S.; Major J. R. Erskine-Murray, D.Sc.; Prof. H. M. MacDonald, F.R.S.; Prof. J. W. Nicholson, D.Sc., F.R.S.

Sub-Committee B on Atmospherics.—Colonel H. G. Lyons, D.Sc., F.R.S. (chairman); Mr. A. A. Campbell Swinton, F.R.S.; Prof. S. Chapman, F.R.S.; Major H. P. T. Lefroy, D.S.O., M.C., R.E.; Mr. G. L. Taylor, F.R.S.; Mr. R. A. Watson Watt; Mr. C. T. R. Wilson, F.R.S.

Sub-Committee C on Directional Wireless.—Mr. F. E. Smith, O.B.E., F.R.S. (chairman); Mr. N. P. Hinton; Capt. C. T. Hughes, M.C., R.E.; Capt. J. Robinson, M.B.E., R.A.F.

Sub-Committee D on Thermionic Valves.—Prof. O. W. Richardson, D.Sc., F.R.S. (chairman); Mr. E. V. Appleton; Capt. S. Brydon, R.E.; Capt. H. L. Crowther, R.A.F.; Prof. C. L. Fortescue, O.B.E.; Mr. B. Hodgson, M.Sc.; Prof. F. Horton, D.Sc.; Major A. G. Lee, M.C., R.E.; Mr. H. Morris Airey, O.B.E., M.Sc.; Mr. R. L. Smith-Rose; Prof. R. Whiddington, D.Sc.

SUBMARINE CABLE TELEGRAPHY.

A Rising "Cable-*Constant*": A Make-shift Term.

By EDWARD RAYMOND-BARKER.

(*Concluded from page* 165.)

Parallel with the above-mentioned increase in the speed factor over any given K R, has been the rise in message traffic output, due, first of all, to successful application of the *duplex* principle to cables. Likewise general circuit-efficiency has been conduced to by satisfactory working out—on truly theoretical, and, therefore, essentially practical lines—of effective systems of cable automatic retransmission or translation. Such have been the results of using S. G. Brown's drum-relay, Dr. Muirhead's vibrating-gold-wire relay, and in recent times the Eastern Telegraph Co.'s and B. Davies's "Dipper" cable-relay, not forgetting the amplifiers.

Therefore, according to requirements of present-day practice, the working efficiency of a chain of cables—with, perhaps, a considerable stretch of land-line, overhead or underground, at each end of this telegraphic system uniting, maybe, two capital cities—is determined, not so much by high "speed constants" severally pertaining to the cables, as by discriminating adoption and effective maintenance of an auto-transmission system, duplexed, in conjunction with cable auto-repeaters conjointly, perhaps, with amplifiers; this combination permitting practically direct working between the two extreme terminal stations at important commercial centres. At both these places, signals, received at a speed sufficiently high to cope with traffic demands, are automatically printed in duplicate in Roman type, respectively for delivery to the public, and for possible future official reference. In order to attain a big traffic output, high "speed constants" certainly are most desirable, but more desirable still is "through" automatic translation with automatic Creed typing at extreme terminal stations, which, in this manner, are kept in direct unbroken touch, one with the other.

It is true that on a given cable circuit, *duplex* does not double traffic capacity, that is to say, the maximum legible signalling speed in each direction is not the equivalent of the speed possible over the cable *simplex*. This increase in traffic output is not 100 per cent., but about 90 per cent., or even less.

The main cause of this decrease, apart from reasons given by Dr. Malcolm on page 476 of his valuable book before referred to,* is that the electrical devices adopted to mask or smooth down a necessarily imperfect duplex balance—exposed as this is to abrupt impact of outgoing currents—tend to lower sensitiveness and effective speed of reception.

This mention of balance imperfection does not reflect on the keen men responsible for the attainment and maintenance of cable duplex balances, because, obviously, the ordinary artificial cable, whether built up on Stearn's, Muirhead's, or Dearlove's system, balances only inductive capacity and conductor resistance, and the rate at which this combination takes up electric charges. Recently the use of a certain amount of inductance has been adopted. Conditions regarding inductance, leakance, and other complex electrical characteristics differ greatly in the artificial line compared with the real cable, so these many contributive minor causes conducing to a "ragged" balance, have to be masked or "got round" somehow by devices—some theoretical, others purely empirical.

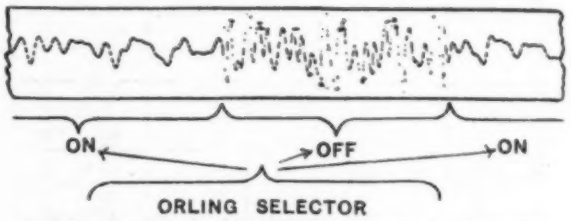
Naturally, with the appearance of the cable receiver current-amplifier or magnifier, the afore-mentioned difficulties have become greatly accentuated, for the more sensitive the amplifier, the more easily is its delicately contrived high-speed signalling upset by impact, at the apex of a *non*-absolute bridge balance, of out-going abrupt comparatively high-potential square-topped currents at present in general use.

This accounts for the existing difference between "cable constants" *duplex* and "cable constants" *simplex*. As, recently, a leading cable man succinctly expressed himself to the present writer: "Of course, all duplex speeds with magnifier apparatus depend on the degree of perfection to which the balance can be reduced and maintained under working conditions. This is the limiting factor with magnifier reception."

One of the most effective ways of attaining and maintaining a high standard of circuit efficiency is the suppression or elimination of sources of trouble due to untoward electrical conditions.

An instance of such untoward conditions is afforded in the already-referred-to enforced limitation of amplifier speeds due to necessarily imperfect duplex balance which though, perhaps, good enough for *direct* reception, shatters the working of the ultra-sensitive magnifier, unless this last-mentioned instrument—the very *raison d'être* of which is high speed—is mercilessly damped down, being thus, in great part, robbed of its most striking characteristic—*speed*. In short, the problem has been the paradoxical one of how to work *duplex* without sacrificing signalling speed.

At last, this—at one time—seemingly insuperable difficulty has been overcome. We are face to face with



Cable Signals. Duplex. Outgoing Transmission Continuous.

Fig. 2.

facts in the shape of specimen slips from a *duplexed and duplex working ocean cable*—proving that this problem has been solved by Mr. Axel Orling, inventor of one of the relays or amplifiers mentioned by "A. F."

The electrical device (patented at home and abroad) effecting this improvement, dates from laboratory experiments before the great war which, in a hundred ways, delayed verification on the cables. It was devised, in the first instance, shortly before the war, for use at an ocean cable station, as a selective damper of local inductive disturbances due to adjacent electric tramways; and, indeed, it has recently been proved perfectly effective in blocking out spasmodic, local electrical disturbances.

From its inception, the present writer has felt convinced that this device would prove equally effective and equally selective in the duplex difficulty, and would flatten out abrupt disturbances due to small irregularities in the duplex balance.

In a letter published in the *Electrician* of February 25th, 1916, the present writer expressed himself as follows with reference to actual trials, on the cables, of the Orling jet relay and amplifier, though, in the letter in question, no mention is made of any particular inventor or instrument:—

". . . Sending-current impact in duplex working, in one instance, and local electric disturbances in

* "The Theory of the Submarine Telegraph and Telephone Cable," by H. W. Malcolm, M.A., Ph.D., D.Sc. Benn Brothers, 8, Bouverie Street, E.C.4.

another, arose as obstacles, in two concrete cases." (On the cables.) "These difficulties have been successfully overcome, it is reasonably believed, without any impairing or lowering of amplifier sensitivity or high-speed characteristics. Further trials—after war—will show this. . . ."

Whether, or not, these last-quoted words were justified is shown by the accompanying illustration, fig. 2, which requires little explanation.

This short piece cut from many yards of actual traffic slip throughout the whole of which *outgoing* as well as incoming traffic proceeded without cessation, shows received signals, as recorded through the medium of an Orling relay, under two conditions, namely:—

1. With selector device applied, that is to say, *on*, and

2. With the device *off*.

In the latter case signals are shattered; in the former case duplex disturbance is eliminated, while cable signals are left unimpaired. The foregoing test was made with an Orling amplifier in shunt with other receiving apparatus *plus* a high resistance, and using only 1/24 of the available received current. No adjustments were made to shape up the signals, the test being only as relating to elimination of disturbances.

The said selective device of Mr. Axel Orling has been referred to and illustrated in the Electrical Review of February 6th, 1920.

We now return from a digression made to show, by an excellent example, how under certain conditions—

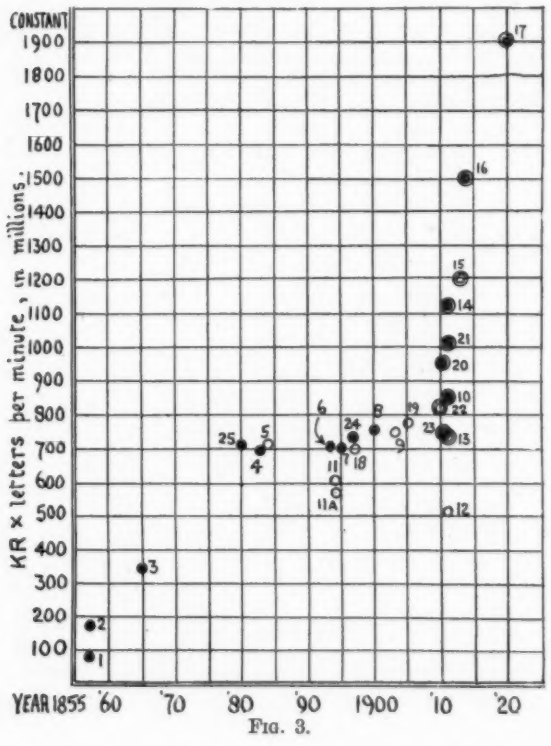


Fig. 3.

in this case, cable *duplex*—an amplifier will suffer, so to speak, from the faults of its good qualities, until, under the discriminating action of a well-contrived device, disturbances are eliminated, circuit efficiency increased, and the high possibilities of the modern "cable constant" rid of all clogging obstructions.

In conclusion, fig. 3 shows what—on the basis of data noted by the writer for many years past, and up to the present time—may be considered a rough approximation of the "cable-constant" curve—a curve developed purely and simply by improvements in signalling methods in conjunction with increased dimensions of cable cores; though here it may be remarked that adoption of a highly efficient amplifier would render possible satisfactory and paying speeds over cables with comparatively light cores—a fact involving material reduction in cable manufacturing costs.

In fig. 3 the higher plottings may not, as yet, be in actual daily practice, but they certainly are feasible, and enough has been done over ocean cables to justify the said higher plottings as here presented.

Though quite apart and independent in their respective lines of investigation and achievement no two names can be more fittingly associated in the later formation of the curve than are those referred to by the Electrical Review's reviewer, "A. F.," in his interesting *compte rendu* of the most recent edition of Dr. Fleming's book on "The Propagation of Electric Currents in Telephone and Telegraph Conductors."

There remain a few notanda relating to plottings in fig. 3:—

Ordinates.—"Cable constants."

Abscissæ.—Time, in years.

Black plottings refer to "constants" *simplex*, direct reception.

Small circular ditto mean *duplex*, direct reception.

Plottings with outer circles signify amplifier-magnifier reception.

Plottings Nos. 1, 2, and 3 are based on values derived from data found in Sir Charles Bright's book on "Submarine Telegraphs."

Plotting No. 4 is a graph equivalent of a constant derived from speed test made by Dr. Muirhead on the Western Union, 1883, Penzance-Canso cable. Useful data regarding the same have appeared for many years past in "Munro and Jamieson." K R = 7.19 at sea temp.

No. 5.—A N. Atlantic cable (K R = 6.2) cited on p. 810 of the *Electrician*, September 15th, 1916.

No. 6.—A S. Atlantic cable. K R = 4.57.

No. 7.—From published data.

No. 8.—Brest-Cape Cod cable. Working K R = 7.5 or (?) 8.

No. 9.—San Francisco-Honolulu cable. K R = 5.

Unofficial speed-test made at Honolulu by E. R.-B. shortly after the laying of this cable from the telegraph steamship *Silvertown*.

No. 10.—From general data given in the *Electrician*, September 15th, 1916.

No. 11A.—"Anglo-American," 1894, heavy-core cable. K R = 2.42 with speed results of 250 *l.p.m.* by Mr. P. B. Delany.

No. 11.—Same cable with speed noted by Mr. A. Dearlove, 237.5 *l.p.m.* (47.5 w.p.m.). See Mr. Dearlove's interesting article in the *Electrician*, October 12th, 1894; also the most useful article in the Electrical Review, June 9th, 1899.

No. 12.—An ocean cable of still heavier core, but longer than the last mentioned. K R = 2.64 (early record).

No. 13.—Ditto, ditto, with Magnifier (Dx).

No. 14.—Ditto, ditto, with Magnifier (Sx).

No. 15.—Successful experimental trial with M. on ocean cable. K R = 4. Observed speed—by no means *maximum*—very nearly 300 l.p.m. Already referred to, and illustrated in this same article.

No. 16.—Heavy core cable. K R nearly 8. Experimental trial with magnifier with successful results.

No. 17.— Ditto, ditto; a more recent test.

No. 18.—Vancouver-Fanning Island cable. K R = 9.11.

No. 19.—Ditto, ditto; later.

No. 20.—Ditto, ditto; later with magnifier.

No. 21.—Ditto, ditto; simplex with magnifier.

No. 22.—Ditto, ditto; duplex with magnifier.

No. 23.—A N. Atlantic cable with magnifier. K R = 5.

No. 24.—Cable K R = 5.46, and speed of 135 *l.p.m.* cited in "Notes," the *Electrician*, April 23rd, 1897. (Editorial data evidently inspired by E. T. Co. authority.)

No. 25.—Pernambuco-St. Vincent No. 1 cable. K R = 4.57 and 155 *l.p.m.* actual traffic. Test made in 1880 at Pernambuco by R.-B. (See "Munro and Jamieson.")

The foregoing few instances of K R *l.p.m.* in practice are but a "drop in the ocean" compared with the host of examples available elsewhere. However, the general trend of the "cable constant" is roughly indicated by these plottings which—while they are not exactly in accord with "A. F.'s" expression "a very arbitrary quantity," as applied to the cable constant—amply justify "A. F." in his suggestion that generally received standards, whatever these may have been, have, of late years, "been badly upset by such delicate receiving instruments as the Orling and Heurtley relays."

Errata.—In the first portion of this article [p. 164, August 6th issue] under fig. 1, for "3×300" read "4×300"; and in column two, second paragraph, for "(eligible maximum)" read "(legible maximum)."

EXTRA LONG-DISTANCE TRANSMISSION OF ELECTRICAL ENERGY.

Principles and Applications of the Quarter-Wave and Half-Wave Systems.

The world-wide rise in costs of fuels, the short supplies thereof, and the increased demand for industrial power are factors which have made the long-distance transmission of electrical energy a matter of primary importance. The economics of electrical transmission at moderately low voltages and over distances up to 200 miles may be said to be understood completely, and to be capable of exact calculation. Accepted limits may, however, be removed, and the economic possibilities of hydro-electric and super-power station schemes enormously extended by the so-called "quarter-wave" and "half-wave" systems which, it is claimed, make possible economical trunk line transmission over distances up to 600 or 1,000 miles. Such a claim deserves to be considered in detail, and in the following paragraphs we reproduce the most important statements from papers by M. P. Bunet in the *Revue Générale de l'Electricité*, and a communication by M. Brylinski to the Académie des Sciences.

Limits to Transmission from Constant-Voltage Station.—As representing a reasonable limit to electrical transmission by ordinary means, we may consider the delivery of 27,000 KW. at a distance of 310 miles (500 km.), and at a pressure of 100,000 volts between lines and earth, *i.e.*, 173,000 volts between wires. This would necessitate the use of about 460 tons of aluminium in the conductors, and the frequency being 50 cycles per second, the pressure increase needed to maintain constant voltage at the supply end of the line would be :—

1·2 % at cos ϕ = 1·0,	corresponding to	78·4 % efficiency,
9·5 % at cos ϕ = 0·9,	"	82·7 % "
14·0 % at cos ϕ = 0·8,	"	85·3 % "
and 19·4 % at cos ϕ = 0·7,	"	82·7 % "

On the basis of pre-war costs, 1s. 1d. per lb. for aluminium, the cost of line conductors would be 40s. 6d. per max. KW. transmitted, *i.e.*, a relatively low amount compared with the total cost of hydro-electric and receiving stations which exceeds £80 per KW. installed and transmitted.

Suppose, now, that it is desired to transmit energy to a much greater distance—say, 930 miles (1,500 km.). The working pressure can hardly be pushed much higher than the 173,000 volts assumed as the delivered pressure in the above example, corresponding to 200,000 volts at the generating station. At such pressures troubles with corona discharge have already become considerable, and, this limit depending upon the natural dielectric (air) between overhead lines, it is improbable that further advances in practice will make possible such increase in working voltages as would enable energy to be transmitted economically over distances of 600 to 950 miles by a mere extension of existing methods.

Moreover, where such distances are concerned, the variation in transmission voltage needed to maintain constant voltage at the load is a serious factor, and, owing to the influence of inductance and capacity (which increases almost in proportion with the distance), it is not sufficient merely to double the cross section of the line in order to transmit a given power for double the distance at given voltage and with given efficiency.

For a distance of 310 miles (500 km.) a self-induction reactance ω L of 0·4 ohm per km. at 50 cycles gives a total of 200 ohms, and corresponds, in the case of 100 amperes in an aluminium cable of 1 sq. cm. section, to 20,000 volts per phase in quadrature, or 20 per cent. of the total voltage. The capacity, about 0·01 microfarad per km., is responsible for a charging current of 157 amperes, *i.e.*, about 1½ times the useful current. Taking a cable of twice the above section, carrying twice the current, the charging current is reduced to three-fourths the useful current, but the voltage in quadrature rises to 40,000 volts, *i.e.*, to 40 per cent.

Thus, from the point of view of voltage regulation, 310 miles (500 km.) and 100,000 volts per phase are practically the limiting distance and pressure. Automatic pressure regulators might be used to maintain constant voltage at the distant end of the line by operating upon the generators, but in such extreme cases the conditions are unfavourable both for automatic regulators and for satisfactory parallel operation of the generators.

In order to understand how these difficulties and limitations may be overcome, it is necessary to consider certain fundamental laws and characteristics relating to overhead conductors.

Relationship Between Capacity and Inductance in Overhead Lines.—The coefficient of self-induction of an overhead line, in which the distance D between conductors is large compared with their diameter d, is given by $L_1 = 4{\cdot}6 \times \log 2\,(D/d) \times 10^{-4}$ henry per km. The capacity between conductor and neutral is given by $C_1 = 0{\cdot}24 \times [1/(\log 2\,D/d)] \times 10^{-7}$ farad per km. From these two expressions it is found that $\sqrt{(1/L_1 C_1)} = 300{,}000$ km. per second, which is the speed of light. The same result is obtained by using the values L_1', C_1', the self-inductance and capacity of all the conductors per unit length. Inductance per unit length has, in fact, no dimensions, and the square root of the inverse of capacity per unit length has dimensions $L\,T^{-1}$, *i.e.*, the dimensions of a velocity.

Similarly, considering the case of a small conductor of radius a_1, placed at the centre of a cylinder of radius R and separated therefrom by an insulating medium of specific inductive capacity k and permeability μ—these being the fundamental components of a concentric cable—we find that R, a_1 cancel out and that $\sqrt{(1/L\,C)}$ in this case $= [1/\sqrt{(\mu\,k)}] \times 300{,}000$ km. per second. The coefficient $1/\sqrt{(\mu\,k)}$ is that given by Maxwell for the ratio of the speeds of propagation in various media.

Let us assume a current of frequency f and a line *open at its far end* and of length l such that, with speed of propagation v, the manifestation of a certain state at the emission end arrives at the far end when the phase has changed ¼ period. Then $l/v = 1/(4f)$, and this equation is satisfied by a length of 1,500 km. in the case of 50 cycle current, *i.e.*, 1,500/300,000 = 1/200 = 1/(4 × 50).

Such a circuit is in resonance for frequency f under the influence of self-inductance and capacity distributed along the line. In the case of a circuit containing a single inductance L and capacity C, the condition for resonance is $f = 1/[2\,\pi\,\sqrt{(L\,C)}]$. In this case, however, to allow for the distribution of the inductance and capacity, and for the quarter-period difference in phase along the line, we must modify the product of length by unit inductance (or capacity) by the extra term $2/\pi$. Then $L\,C = 2/\pi \times l \times L_1 \times 2/\pi \times l \times C_1 = (4/\pi^2)\,l^2\,L_1 C_1$. Hence $f = 1/[4\,l\sqrt{(L_1 C_1)}] = v/4\,l$, and therefore $v = \sqrt{(1/L_1 C_1)}$, which shows that v is independent of the length l.

These relationships show that the velocity of electricity—hitherto considered to be negligible in connection with the distribution of electric power—plays an important part where distances of the order of 900 miles are concerned. Also, these relationships form a basis for considering the special properties of quarter-wave lines.

Quarter-Wave Lines.—The quarter-wave line comprises two conductors for single-phase working, or three for three-phase operation, so arranged that they are in resonance on light load. On applying a p.d. to one end of such a line, the voltage at the other end would be infinite if the resistance were zero. This characteristic is repeated for all the odd harmonics.

With a frequency of 50 cycles per second, the condition of resonance is satisfied by the natural inductance and capacity of overhead lines 1,500 km. in length; and with a frequency of 25 cycles per second, the corresponding distance is 3,000 km. It is not necessary, however, to adhere to these distances and to use only the inherent inductance and capacity of the lines. It is always possible to increase the inductance by inserting reactance coils in the lines and the difficulties in constructing E.H.T. condensers are avoided, because the capacity of the conductors themselves is sufficient in the present system.

If, instead of being open at the far end, the above line be connected to a load-circuit, constant p.d. is obtained at the point of delivery if constant current be maintained at the beginning of the line—the effect of the resistance of the line being left out of consideration. On this basis the received potential is constant if the input current be constant, and, inversely, the received current is constant if the p.d. be constant at the beginning of the line.

The received current is in quadrature with the voltage at the supply end, and the delivered p.d. is in quadrature with the current at the supply end. In other words, the power factor is the same at both ends of the line.

The losses in the line and its regulation are due only to the resistance of the line, and, in spite of this resistance, a better result is obtained than with constant-voltage transmission.

Characteristics of the Quarter-Wave Line Allowing for Resistance.—The following example shows the results obtained in a practical case, allowing for the effect of resistance. With resistance present, it is no longer possible to obtain constant delivered p.d. by maintaining constant current at the supply end of the line, hence it is convenient to inquire :—What variation of current is required at the supply end to maintain constant delivered p.d. at various loads and various power factors? Choosing 50-cycle operation and a distance of 750 miles (1,200 km.), we have a margin for adjusting the conditions of the line if resonance is not obtained on open circuit. If l = length of line; L_1, C_1 = self-induction and capacity respectively per km.; $x = 2\,\pi\,f\,L_1$ = say, 0·5 ohm; and $b = 2\,\pi\,f\,C_1$ = say, $3{\cdot}5 \times 10^{-6}$; then, by a simple transformation of $f = 1/[4\,l\,\sqrt{(L\,C)}]$, we have that resonance is obtained when $\sqrt{(b\,x)} = \pi/2\,l$, if resistance be neglected. In the present case $\sqrt{(b\,x)} = 1{\cdot}32 \times 10^{-3}$, and $\pi/2\,l = 1{\cdot}31 \times 10^{-3}$. Let us suppose that there is delivered 250 amperes at 100,000 volts phase-voltage (173,000 volts star). Choosing an aluminium cable of 5 sq. cm. section, the resistance per km. is r = 0·07 ohm, and the weight of the lines is 5,000 tons, *i.e.*, 148 lb. (67 kg.) per KW. transmitted,

which is a very reasonable figure for transmitting 75,000 KW. a distance of 1,200 km.

Table I shows corresponding values of the input-current, and of the current delivered for full-load, ¾-load, ½-load, and ¼-load at various power factors, and finally for operation on light load and for operation with 75,000 K.V.A. all reactive.

TABLE. I.—Current input to and Current Delivered by Quarter-Wave Line.

elivered (at 100,000 volts).			Input.				—
KW.	Power factor.	Amps.	Volts.	Amps.	Power factor.	KW.	Efficiency.
75,000	1·0	250	106,600	293·2	0·993	93,000	80·5 %
	0·9	278	115,100	294·9	0·882	90,000	83·3 %
	0·8	312	126,500	296·0	0·797	89,600	83·7 %
	0·7	357	142,100	297·4	0·713	90,300	83·0 %
56,250	1·0	187·5	82,700	286·3	0·994	70,600	79·7 %
	0·9	208	88,600	287·3	0·886	67,700	83·0 %
	0·8	234	97,000	288·2	0·801	67,200	83·7 %
	0·7	268	108,400	289·0	0·715	67,200	83·7 %
37,500	1·0	125	58,800	279·2	0·995	49,000	76·6 %
	0·9	139	62,200	280·0	0·899	47,000	79·7 %
	0·8	156	67,300	280·5	0·817	46,300	81·1 %
	0·7	178	74,400	281·0	0·727	45,500	82·5 %
18,750	1·0	62·5	35,000	272·1	0·998	28,500	65·8 %
	0·9	69·5	36,000	272·5	0·930	27,300	68·6 %
	0·8	78	38,000	272·8	0·863	26,800	69·8 %
	0·7	89	40,900	273·1	0·785	26,200	71·5 %
Open circt.	—	—	11,300	265·2	0·994	9,000	—
75,000 KVA. reactive.	Zero	250	94,600	270·0	0·194	14,900	—

Obviously, it would be possible to construct an apparatus regulating the current input in accordance with the load on the basis of the figures given in Table I. Column 5 of the latter shows that, in order to maintain 100,000 volts phase-voltage at the point of delivery, it is sufficient to increase the current input from 265 amperes on light load to 295 amperes on full load, *i.e.*, by about 11 per cent. The received voltage will be constant within about 1 per cent. if the current input be 265 amperes plus 7 amperes per 18,000 KW. This regulation is better than that resulting from ohmic drop alone, and it will be seen from the table that *the power factor of the load has no important influence on the regulation*. The input current leads on the voltage received by from 89° 10′ to 94° 40′, *i.e.*, always about 90°. Similarly, the p.d. at the input end of the line leads on the current delivered by from 87° 40′ to 100° 20′—again a nearly constant lead of about 90°. Thus the power factor is practically equal at both ends of the line (see Table I).

The input voltage equals the quotient of the delivered voltage by the power factor at full load, and decreases with the load to 11,300 volts on open circuit. Assuming that the power factor does not fall below 0·8 on full load, the maximum voltage between lines at the generating station is 219,000 volts. At and above half-load the efficiency is practically independent of load, and is about 82 per cent. It may be increased by using larger conductors. Comparing this with continuous-current transmission on the series system, with the same weight of conductors, say, two of 7·5 sq. cm. section, and assuming an input voltage of 225,000 volts, there will be delivered 420 amperes at 178,000 volts, *i.e.*, an efficiency of 79 per cent., which falls to 65 per cent. on half-load. Again, the A.C. system would gain about 10 per cent. at the delivery point at full load, and 15 per cent. at half-load, by the use of transformers in place of the machines required by the D.C. series system, hence at half-load we may compare 82 per cent. efficiency in the A.C. system with 50 per cent. net efficiency in the D.C. system. At quarter-load the efficiency of the A.C. system is 69 per cent. compared with 48 per cent. for the D.C. system, and to this difference of 21 per cent. there may be added another 20 per cent. due to the elimination of the rotating machinery required by the D.C. system.

Disadvantages of the Quarter-Wave System and Precautions Necessary.—The above results are excellent, and much better than would ordinarily be expected for the transmission of 75,000 KW. over such small conductors for a distance of 750 miles. Nevertheless, the quarter-wave system has certain disadvantages and limitations which we may now proceed to discuss.

(*a*) *Maximum Line Voltage.*—The first point to be investigated is the nature of the pressure distribution along the transmission line. At full load the voltages at the two ends are of the same order, but the question naturally arises whether excessive potentials may not be attained at intermediate points. The figures given in Table II show the phase pressures attained at intermediate points, when supplying full load (75,000 KW.) at various power factors.

TABLE II.—Phase Voltage at Intermediate Points on Quarter-wave Line.

Distance from point of delivery. Km.	Voltage at point considered, with power factor. 1·0.	0·9.	0·8.	0·7
0 (delivery end) ...	100,000	100,000	100,000	100,000
300	101,000	121,000	134,000	145,000
600 (mid-point)	100,000	125,000	141,000	156,000
800	99,000	124,000	140,000	158,000
1,200 (station end)... ...	106,600	115,000	126,000	142,000

At ¾-load the phase voltage does not exceed about 130,000 volts; on light load the over-voltages disappear; and on purely inductive loads they reappear, being of the same order as on full load when the current is 250 amperes.

The star voltage between lines may rise to about 275,000 volts, which does not constitute a limiting factor, because it is obviously easier to insulate a line for 275,000 volts than it is to insulate transformers and switchgear for 225,000 volts, the latter being the normal requirement of the case considered.

(*b*) *Effect of Opening Circuit.*—Suppose that the line be operating under full load, with a supply voltage of 113,000 volts, corresponding to a power factor of about 0·9, what will be the effect of opening the circuit suddenly at the load end? It is assumed that the supply station is equipped with extra-rapid regulators, so that the current falls instantly from 295 amperes to 265 amperes (see Table I), the works pressure being reduced simultaneously to 11,300 volts, *i.e.*, to one-tenth of its full-load value. The pressure at the delivery end remains constant at 100,000 volts, and the line being in resonance on open circuit, the pressure required at the station end would be zero but for the presence of resistance.

Suppose, however, that the regulators in the supply station do not operate instantaneously. Instead of the 11,300 volts required to maintain 100,000 volts at the far end of the line, we shall then have 113,000 volts at the works, and we might expect the voltage at the far end to rise to 1,000,000 volts. This corresponds to the risk of infinitely high voltage in the D.C. series system should the line circuit be opened, but, as a matter of fact, there are in both cases circumstances which restrict these dangerous pressure rises.

Let us consider how the load may be interrupted. At the delivery end of the line there is a transformer station which may be connected to the line through cut-outs operating after those on the low-tension side. Thus, when the latter open, the transformers remain connected to the line. The saturation of the transformers may be made such that their no-load current is 5 per cent. of the normal current, absorbing 5,000 K.V.A. for 100,000 K.V.A. full load, the induction being, say, 13,000 gauss, requiring 9 ampere-turns per cm. The current absorbed will then be 5,000 K.V.A./(100 KV. × 3) = 16·7 amperes.

If the terminal voltage be increased to 125,000 volts, or to 135,000 volts, we have the following conditions:—

Terminal voltage ...	...	125,000 volts	135,000 volts
Induction, in gauss	...	16,200 ,,	17,500 ,,
Ampere-turn per cm.	...	60 ,,	100 ,,
Current	...	110 amperes	185 ,,
Kilovolt-amperes ...	...	33,000 ,,	55,500 ,,

These transformers are not of standard design, but there is no reason why they should not be built, using iron of very low hysteresis loss.

We have seen that the over-voltage is suppressed with about 250 amperes reactive at the delivery end, and if with 35 per cent. over-voltage we have already a current of 185 amperes, we shall not have voltages much above the latter.

Again, supposing that 125,000 volts at the delivery end is obtained with 60 amperes in quadrature, there is required 23,700 volts and 335 amperes at the station end. Similarly, 125,000 volts and 120 amperes in quadrature at the delivery end requires 44,500 volts and 351 amperes at the station end; and 135,000 volts 180 amperes in quadrature requires 66,800 volts, 410 amperes at the station.

Thus, in order to produce a considerable over-voltage at the far end of the line, the current in quadrature rising rapidly with the voltage, it is necessary for the current to rise considerably at the station end, and this offers a good opportunity for the use of supplementary regulating gear or automatic cut-outs.

Another case to be considered is that of total removal of load, including the reactive current, as in the case of line breakage near the delivery end. In this case also the current regulating devices at the station end prevent excessive voltage rise at the delivery end of the line. If these devices do not operate promptly, the delivered voltage cannot rise considerably without the current rising at the station end because, when the delivered current is zero, the input conditions for various voltages at the delivery end are as in Table III:—

TABLE III.—Input Conditions for Various Delivery Voltages on Open Circuit.

Delivered voltage.		Input, amperes.	Station voltage.	Input, KW.
100,000	...	265	11,300	9,000
125,000	...	331	14,100	14,000
135,000	...	359	15,300	16,500

Even in this case where the transformer losses have not to be considered (the break being on the station side thereof) the power absorbed by the line increases rapidly with the delivered voltage, and the current input rises sufficiently to ensure that the station regulators or cut-outs come into action.

The rapid increase in the power absorbed by the line and dispersed by radiation at increased pressures must not be overlooked. Electrolytic and lead oxide lightning arresters have both the property of absorbing an amount of power which increases rapidly with voltage once the latter exceeds a critical value. By distributing such arresters along the line, the latter is protected against lightning as well as over-voltages.

(*To be continued.*)

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Simple Time-Checking System.

The device described below was in use in one of the large French works during the war, and was employed in that particular instance for checking the total time, each day, during which the individual units of a number of cold draw-benches were actually operating.

The sketch (fig. 1) shows, diagrammatically, one unit of the time-checking apparatus which consisted of the following

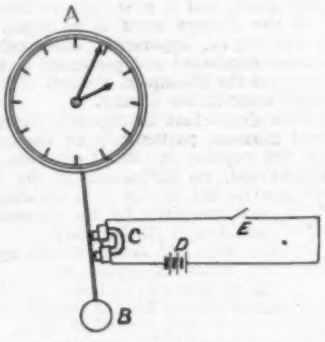


Fig. 1.—A Simple Time-checking System.

parts: A is an ordinary cheap clock fitted with a pendulum B, and is situated in the foreman's or shop manager's office; C is an electromagnet, energised by a battery D, and E is a contact maker, completing and maintaining the battery circuit when the draw-bench is tight, *i.e.*, doing its work.

The operation is very simple. The electro-magnet C is set with its poles almost touching the pendulum rod at the end of its swing. Now if the contact maker E closes the circuit the magnet will be energised and hold the pendulum just so long as E makes contact, thus stopping the clock; when E breaks circuit the pendulum is released, and the clock runs normally until again stopped by E closing. The contact maker E is fitted on the draw bench so that when the chain is tight E makes contact, and the clock is stopped; directly the chain slackens E breaks circuit, and the pendulum is released. Each draw bench is furnished with a contact, and each has its corresponding clock in the foreman's office. Every morning the clocks are set to the correct time, and at the end of the day each will have lost to the extent of the time during which its draw bench has been in actual operation.

The system can, of course, be applied to any kind of machinery, and enables an accurate record to be kept of intermittent operations on a number of similar machines.

The Watt Motor.

Much interest was shown in the demonstrations given recently at Faraday House, London, by The Watt Motor Co., of Premier House, 150, Southampton Row, W.C. 1, of a motor, fig. 2, having a squirrel-cage rotor that will start with almost a full load with a starting current of only 40 to 50 per cent. above the normal current. It may be constructed for single or polyphase currents, for various speeds, voltages, and periodicities, and at present in sizes of from 1 to 7.5 H.P. The motor is simply started by means of a star-delta switch on the stator frame, which at the same time takes the place of the commonly-used knife switch. No starting resistance is used.

Fig. 2.—The Watt Motor.

Thus attendance becomes easier as no starting or regulating devices are necessary. The absence of slip rings and bush gear aids in the elimination of running troubles, and reduces maintenance costs and the fire risk. Space is also economised, due to a squirrel-cage motor being from 15 to 20 per cent. shorter than a corresponding slip-ring machine. Particulars of the motor tested are: 7.5 H.P.; 1,420 R.P.M.; 380 volts; squirrel-cage rotor; 50 cycles, 3-phase.

The results of efficiency tests are set out below:—

B.H.P.	7·5	5·63	3·75	1·87	Nil.
Amps.	11·9	9·3	7·0	5·2	3·9
Power factor ...	0·86	0·82	0·73	0·54	0·22
R.P.M.	1415	1440	1455	1472	1497
Slip %	5·7	4·0	3·0	1·9	0·2
Efficiency % ...	83	85	84	75	Nil.

The testing pressure was approximately 390 volts, and the current taken by the motor with the switch in the first position was about 15 amps., while with the rotor locked it was about 18 amps. The torque at standstill position was 22.9 lb., or about 83 per cent. of the full-load torque.

A New Telephone Receiver.

Our illustration, fig. 3, which we reproduce from the *T. & T. Age*, shows a cross sectional view of an automatic receiver for manual telephone systems, that has been invented by Mr. E. E. Ries, of New York. The receiver is about the same width, but only half as long, as the ordnary standard disk set receiver, and the novelty is that the receiver is not used to close the signaliing circuit. The Ries receiver has a self-contained switching element which renders switching gear inside the telephone stand unnecessary. The received does not need to be hung on a hook, but may be set on a desk anywhere within reach of the user. In the centre in a sealed cup-like receptacle is a deposit of mercury; when the receiver is lifted and moved toward the ear of the user the mercury falls in a direction so that it effects a momentary electrical

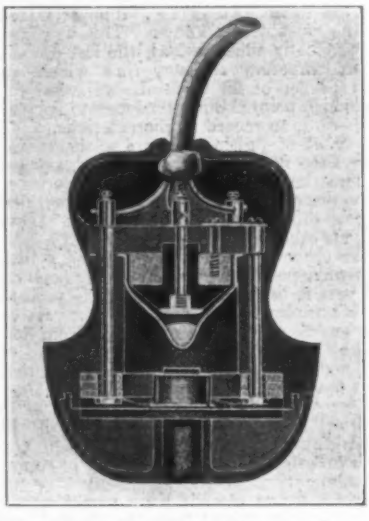


Fig. 3.—A New Telephone Receiver.

contact between the metal of the cup and a contact disk, shown just above the mercury in the illustration. The closing of this contact accomplishes the same purpose as does the switch-hook in a standard desk set; that is, it closes the signalling circuit which attracts the attention of the operator at central. Should the operator not respond promptly, when this receiver is used, it is not necessary to "juggle" a switch-hook, but only to tilt the receiver slightly so that the column of mercury may once more make a momentary contact. The use of a receiver of this type does away with switch-hook troubles, and as the quantity of mercury employed is sufficient to in all cases insure proper contact between the points to be connected, it would seem that the operation of the signalling circuit is at all times positive, and the contact of sufficient duration to give a positive signal. One difficulty with the switch-hook is that the average telephone user, not understanding the necessity for reasonably prolonged contact, operates the hook too rapidly to permit the lamp at central to light up. Also, it is evident that the entire list of service defects, resulting from users failing to restore receivers to the hooks when finished talking, are avoided by the use of the Ries receiver. The receiver is so designed that no matter how it may be set down on a table or desk it will automatically assume an upright position, thereby disconnecting the signalling circuit to the exchange.

REVIEWS.

Silvanus Phillips Thompson, D.Sc., LL.D., F.R.S. His Life and Letters. By Jane Smeal Thompson and Helen G. Thompson, B.Sc. London: T. Fisher Unwin, Ltd. Pp. ix+372; 13 illustrations. Price 21s. net.

The many students and workers in various paths of science who have had the privilege of passing under the genial guidance of Silvanus Thompson will welcome the glimpse that is afforded by his wife and second daughter, in this book, of his upbringing, home life, and manifold activities in other directions than those in which they themselves came in contact with him. The authors are conscious of their difficulty, because of their nearness to him, in seeing the man in his true perspective; how much more difficult then must it be for those to do so who encountered but one or two facets of this "many-sided crystal."

Most of us who knew "the Doctor" (as he was always called) encountered him at the most impressionable period of our lives, and at the very outset of our professional careers. His wealth of knowledge and his enormous activity provided a splendid example, while the influence of his personal character and of his genial wisdom has shone as a guiding light throughout the lives of many who have never had the opportunity of acknowledging the fact.

Born a Quaker, married to a Quaker, and regarded as a prophet among them to the end of his days, the Doctor was a truly Christian gentleman—upright and honourable, yet free from any narrowminded bigotry. He loved music, was a talented painter, occasionally wrote verse which contained evidence of real poetic feeling, and was a master of lucid English, both as lecturer and as writer.

His career as a teacher of science began at University College, Bristol, in 1876; but in 1885 he became principal of, and professor of physics in, the City and Guilds of London Institute's Technical College at Finsbury, and it was in this capacity that he did his best work and will be chiefly remembered.

The list of his printed books, papers, addresses, and communications to societies, extending over 40 years, fills nearly ten pages of the "Life"; and of these there is no doubt that his "Elementary Lessons in Electricity and Magnetism," frequently referred to in lectures as "this little red book of mine," was the most widely known. This was first published in 1881 and was many times revised, the last occasion being in 1914. Of contemporary reviews, that which appeared in *Nature* from the pen of Sir Oliver Lodge seems to have been the only one which pointed out a tendency to dogmatise, which we afterwards came to regard as characteristic.

He had a habit of putting forward a theory in such convincing form that it came to be accepted as gospel by his students. Thus he announced that many persons, including himself, were disposed to regard electricity as identical with the luminiferous ether—and now, if we are to believe Einstein, the luminiferous ether is simply not there.

We find the chronological method adopted a little difficult, for it is not always possible, without turning back a few pages, to tell what year is being referred to. It is probably best, in writing the biography of one who has been active in many directions, to pursue one branch of activity from the beginning to the end, but every reference to a date should contain the year, and a marginal note showing the year that is being written about facilitates reference immensely.

Thompson was always an attractive speaker at the Institution of Electrical Engineers, though occasionally his forceful manner of speaking made him appear more dogmatic than may have been his intention. At least one student committed himself in an examination to the statement that no ordinary flexible conductor for an electric lamp would stand 120 volts, because the impression gained from the Doctor's contribution to a discussion on a paper on 200-volt lamps by the late Gustav Byng was that a pressure of 50 volts was much better, and anything over 100 was dangerous.

There are one or two inaccuracies in the book, which should be removed from any future edition. Mrs. Ayrton was not elected as, and she is not now, an honorary member of the Institution of Electrical Engineers. The list shows her as an ordinary member who has compounded for her annual subscription. Lord Kelvin was not the first, nor was he at any time the only, honorary member. It is true that the statement that he was the first purports to be drawn from a letter of his own (p. 281), but this is phrased in a curiously misleading manner. Until 1899 the I.E.E. for some reason debarred itself from conferring the distinction of honorary membership upon persons who were still in active practice. Of those who had retired, Adolphe Cochery had been so honoured in 1881, and Henry Wilde in 1898, and both were living in 1899. Kelvin was the first to be elected under the new rules, which removed this illogical disability, and Swan, afterwards Sir Joseph Swan, was the second. The evening reception of the Institution and of the Finsbury Technical College has always been the *conversazione*, not the *soirée*. Professor Miles Walker is not at the University of Manchester (p. 91), but at the Manchester Municipal College of Technology. Von Hefner-Alteneck (p. 171) was not two men, but one. Dr. Walmsley (p. 136) has only one e in his name; "bracketed" (p. 19) has only one t; Reichsanstalt (p. 121) is generally written as one word; Albemarle (p. 156) has only one r; Elihu Thomson (p. 170) is given wrongly as Thompson. The Junior Institution of Engineers was formerly the Institution of Junior Engineers (p. 102). The judgment of Lord Justice North (p. 117) in the telephone case was not that "every surface which can vibrate is a diaphragm," but that "a diaphragm is something which separates something from something else."

The work which Thompson did at Finsbury is worthy of more generous commemoration than it appears likely to get. The College is not ideally situated, and for many years was inadequately equipped. The absence of corporate feeling among the students (p. 132) (in which respect it differs from many of the later polytechnics) and the apparently moribund condition of the Old Students' Association are undoubtedly in some measure due to the lack of any common-room or opportunity for the students to mingle together out of working hours. The college authorities declined to afford a suitable situation for any memorial to be erected there, and it now appears from the papers that the end of the College itself is in sight. The only memorial now existing or, apparently, contemplated, is that his library has been purchased and presented to the I.E.E. to be preserved intact as the Thompson library. There is, or will be, a bust of the Doctor in the library.

There seems little doubt that Thompson's views on national and international matters, particularly on the subject of the Boer war, were not popular in official quarters. Hence he received no knighthood, no distinction at the hands of the State, and was not elected to the principalship of London University, which post was given by the Government of the time (1901) to Professor Arthur Rücker, M.P.

Sir William Ramsay, who had unsuccessfully applied for the headship at Finsbury when Thompson secured it, was the recipient of many official honours; and after his death the collection of a large sum of money for the foundation of research scholarships to his memory was embarked upon. The endowment of Thompson Memorial Scholarships was discussed to some extent, but found little favour, there being apprehensions in some quarters that "scholarships were going to be overdone." But it is not even now too late, and surely the best commemoration of a teacher is to extend his activities to future generations.

Of the 13 illustrations in the "Life," the one which gives the truest impression of the Doctor's never-failing geniality is that at p. 352, where he is shown in the company of his first grandchild.

Wireless Telegraphy. By W. H. Marchant. 305 pages, 201 figs. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

The success attained by the first edition of this book, which was printed five times in as many years, is the best evidence that could be offered as to the value of the treatise. In its second edition the book is revised and enlarged to cover modern practice, and the author has again succeeded in producing a volume which should just meet the requirements of seafaring operators and of students preparing for the P.M.G. certificates in radio-telegraphy. A considerable number of fresh diagrams have been added (the clearness of these has always been an excellent feature of the book), the notes on the Marconi system have been materially extended, and a very useful glossary has been added. The book remains one for the practical man, entirely free from mathematics, excepting the simple fundamental formulæ which must be introduced. Operating principles and constructional details are explained clearly, simply, and in such manner that the reader can proceed from this book to the study of any more advanced treatise without having to "unlearn" anything.

The introductory chapter deals very well with the fundamental quantities and phenomena of capacity, inductance, electrical oscillations, waves and resonance. The treatment given brings one, with very satisfactory promptitude, to the consideration and comprehension of transmitting circuits and equipment. Receiving circuits are then discussed, and it is quite remarkable in these introductory chapters how the author eliminates tedious elementary matter whilst still catering for the needs and limitations of the student who has little or no previous knowledge of electricity. For instance, it is no mean accomplishment to describe clearly the construction and principle of operation of ammeters, voltmeters, wattmeters and frequency meters all in half a dozen pages.

All the main types of detectors are described in Chapter IV, their characteristics being clearly explained, together with their circuits and the adjustments required. Miscellaneous receiving apparatus—the testing buzzer, shunted buzzer, telephone relay, and variometer—are discussed in the next chapter. The use of the vacuum valve as a detector and as an amplifier is explained clearly and in sufficient detail for the present needs of the average operator; it is probable, however, that one or more entire chapters will have to be devoted to the three-electrode tube and its applications in the next edition.

The next half dozen chapters provide a very useful description of the equipment and operation of the Marconi, Poulsen, Telefunken, and Lepel systems, the Goldschmidt high-frequency alternator, and portable installations and small power sets. With one or two unimportant exceptions, the illustrations and wiring diagrams are particularly clear, and the reader will find that these chapters give him an excellent survey of the various systems. Similarly, the last five chapters provide an excellent treatment of radio-measurements,

wiring diagrams, regulations and instructions, abbreviations and codes, and the localisation of faults.

The chapter on measurements covers the principles and apparatus employed and the calculations involved in measuring capacities, insulation resistance, wave lengths, inductances, coupling and resonance, strength of received signals, and so on. The operator should have no difficulty in understanding and applying all the methods described. The chapters on wiring diagrams and their interpretation; regulations and instructions for ships and stations licensed by the Postmaster-General; and abbreviations and codes, call for no special comment save that they are arranged conveniently for reference. The final chapter on fault localisation is, of course, very important, and the procedure laid down should lead to the speedy detection and correction of any probable fault. The author need have no fear that the success of his handbook will not be continued.

Wireless Telgraphy and Telephony. First Principles, Present Practice and Testing. By H. M. Dowsett, M.I.E.E., F.Ph. Soc. Lon., M.I.Rad.E. 331 pages; 306 figs. London: The Wireless Press, Ltd. Price 9s. net.

The author of the present book is the joint author with Mr. J. C. Hawkhead of the Handbook of Technical Instructions for Wireless Telegraphists, which is no doubt well known to all our readers who are engaged in wireless telegraphy. In that book is given a description of the construction and action of the various commercial sets of apparatus produced by the Marconi Company, sufficiently detailed to enable the operator to work and adjust the gear under his charge. The present book is more theoretical. It describes, as fully as possible in the space available, the fundamental physical phenomena on which wireless telegraphy is based, and, without going too far into mere operating details, gives an up-to-date account of the utilisation of these phenomena in wireless practice. A considerable portion of the book is devoted to useful descriptions of methods by which the various measurements and tests necessary in wireless telegraphy are carried out.

The first chapter is devoted to a short account of the work on atomic structure and the nature of electricity, which has been carried out in recent years by J. J. Thomson, Rutherford, and other scientists. The subject of the next chapter is described as "Phase displacement effects in elementary circuits." In this chapter are discussed the effects produced by inductance and capacity in alternating current circuits, the effects of phase alterations on the alternator generating the current, the theory of the transformer, with special reference to its use in wireless telegraphy, and a brief account of the use of vector diagrams in alternating current problems. The third chapter deals with the spark discharge, and discusses the theory of the ordinary spark transmitter, the Marconi synchronous disk discharger, and the quenched gap.

In the fourth chapter brief descriptions are given of the high-frequency alternators of Duddell, Alexanderson, the Société Française Radio-Electrique, and Goldschmidt, the frequency increasing devices of Vallauri and Joly, and the "timed spark" system of the Marconi Company. Then follows an account of the theory of the Poulsen arc, with a short description of actual Poulsen arc transmitters.

The fifth chapter is devoted to a description of the effects due to the emission of electrons from heated metals, and the practical application of these effects in the design of the three-electrode valves so largely used at the present day for sensitive receiving apparatus, and for the generation of continuous waves for ordinary wireless telegraphy and for wireless telephony. Descriptions are given of some sets of apparatus recently produced by the Marconi Company for wireless telephony.

The following chapter deals with high-speed wireless telegraphy. The system of transmission using a high-tension switch controlled by a Creed air engine operated from a Wheatstone transmitter is described, followed by an account of the methods of receiving high-speed signals either on a dictaphone record or photographically by means of an Einthoven string galvanometer.

The remainder of the book is occupied with methods of measurement and testing. In Chapter VII is given a fairly full account of current and electromotive force measuring apparatus. Chapter VIII deals with resistance measurements, including descriptions of the portable resistance measuring instruments known as the "Ducter" and the "Megger," and Chapter IX with the measurement of the low and high frequency capacity of ordinary condensers and of wireless aerials.

In the next chapter are given methods for measuring inductance, both at low and at high frequencies, and in the following one methods for the measurement of frequencies, ranging from that of a rotating piece of machinery to that of the electric oscillations used in wireless telegraphy.

Chapter XII is devoted to the measurement of the dielectric strength of materials, the testing of the insulation of electrical machines and condensers, the designing of insulators to resist high voltages, and the methods by which they are tested, while in Chapter XIII is given an account of the phenomena of damping, and a description of the methods used for measuring the decrement of wireless telegraph circuits.

The final chapter deals with the measurement of the direction and position of transmitting stations, and of the intensity of received signals.

It will be seen from the foregoing brief summary of its contents that the book under review covers in a very complete manner what may be described as the more theoretical side of practical wireless telegraphy. It is very fully illustrated, and although some of the reproductions of photographs of apparatus and machinery are not very clear, the diagrams are excellent. The book is well printed on good paper, and we are sure that it will be found of great use to those readers who, without the advanced mathematical knowledge necessary to read the more abstruse books on wireless telegraphy, yet desire to continue their studies of the subject beyond the stage necessary to enable them merely to handle the gear, without having a clear idea of the functions of the different pieces of apparatus concerned.

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

20,354. "Membraneous transmitter for subaqueous signals." Signal Ges. July 10th. (Germany, March 13th, 1915.)

20,355. "Submarine sound-receiving devices." Signal Ges. July 10th. (Germany, September 8th, 1915.)

20,356. "Transmitting and receiving devices for subaqueous sound waves." Signal Ges. July 10th. (Germany, April 4th, 1916.)

20,357. "Sound producing or receiving devices." Signal Ges. July 10th. (Germany, June 5th, 1917.)

20,358. "Sending or receiving device for subaqueous sound waves." Signal Ges. July 10th. (Germany, September 17th, 1917.)

20,359. "Sound producing or sound receiving devices." Signal Ges. July 10th. (Germany, February 22nd, 1918.)

20,360. "Subaqueous sound producer or receiver." Signal Ges. July 10th. (Germany, July 11th, 1918.)

20,361. "Sound-transmitting arrangement." Signal Ges. July 10th. (Germany, April 14th, 1919.)

20,362. "Sound producers and receivers." Signal Ges. July 10th. (Germany, July 31st, 1919.)

20,363. "Sound producers and receivers." Signal Ges. July 10th. (Germany, August 4th, 1919.)

20,364. "Receiving device for submarine sound signals." Signal Ges. July 10th. (Germany, August 10th, 1917.)

20,365. "Listening devices." Signal Ges. July 10th. (Germany, March 30th, 1917.)

20,369. "Device for ascertaining direction of sound waves." Signal Ges. July 10th. (Germany, May 29th, 1915.)

20,370. "Electro-magnetic vibratory devices." Signal Ges. July 10th. (Germany, July 12th, 1915.)

20,371. "Sound receivers." Signal Ges. July 10th. (Germany, November 29th, 1915.)

20,372. "Sound apparatus." Signal Ges. July 10th. (Germany, February 17th, 1916.)

20,373. "Sound apparatus." Signal Ges. July 10th. (Germany, March 15th, 1916.)

20,374. "Sound-signalling device." Signal Ges. July 10th. (Germany, March 3rd, 1917.)

20,375. "Subaqueous sound producers and receivers." Signal Ges. July 10th. (Germany, November 5th, 1917.)

20,376. "Direction finder for sound waves." Signal Ges. July 10th. (Germany, July 10th, 1915.)

20,390. "Multiplex telephony." Ges. für Drahtlose Telegraphie. July 10th. (Germany, May 27th, 1919.)

20,400. "Thermionic tube electro-magnetic wave generating arrangements." Ges. für Drahtlose Telegraphie. July 10th. (Germany, October 25th, 1918.)

20,401. "Generation of high-frequency currents." Ges. für Drahtlose Telegraphie. July 10th. (Germany, January 19th, 1915.)

20,402. "Thermionic tube electro-magnetic wave generating arrangements." Ges. für Drahtlose Telegraphie. July 10th. (Germany, September 9th, 1918.)

20,404. "Electrodes for searchlights." Optische Anstalt C.P. Goerz Akt.-Ges. July 10th. (Germany, September 19th, 1918.)

20,405. "Electrodes for searchlights." Optische Anstalt C. P. Goerz Akt.-Ges. July 10th. (Germany, September 24th, 1918.)

20,406. "Arc lamps for searchlights." Optische Anstalt C. P. Goerz Akt.-Ges. July 10th. (Germany, October 14th, 1918.)

20,408. "Electric arc lamps." Optische Anstalt C. P. Goerz Akt.-Ges. July 10th. (Germany, June 11th, 1919.)

20,414. "Electro-magnetic tension devices." F. Krupp Akt.-Ges. July 10th. (Germany, June 23rd, 1919.)

20,415. "Electric resistance connections." F. Krupp Akt.-Ges. July 10th. (Germany, November 21st, 1918.)

20,426. "Adjustable ignition means for combustion engines." D. J. Pickee. July 10th. (Germany, August 16th, 1919.)

20,431. "Using dynamo of vehicle as speed indicator." R. Gauthier and Co. July 10th. (France, April 26th, 1919.)

20,440. "Electrical annunciator, &c." G. Schmidt and Boker Co. July 10th. (Germany, March 27th, 1918.)

20,441. "Electric heaters, &c." Majestic Electric Development Co. July 10th. (United States, December 26th, 1917.)

20,465. "Electric accumulators." G. Fromont. July 10th. (France, September 21st, 1916.)

20,466. "Electric accumulators." G. Fromont. July 10th.

20,498. "Cathode generators." Ges. für Drahtlose Telegraphie. July 10th. (Germany, September 9th, 1918.)

20,499. "Conducting coils." Ges. für Drahtlose Telegraphie. July 10th. (Germany, March 4th, 1918.)

20,500. "Production of oscillations by cathode tubes." Ges. für Drahtlose Telegraphie. July 10th. (Germany, April 30th, 1919.)

20,505. "Bow collectors for electric vehicles." C. Conradty. July 10th. (Germany, June 17th, 1918.)

20,506. "Slip pieces for bow collectors." C. Conradty. July 10th. (Germany, September 1st, 1915.)

20,507. "Antenna systems for receiving electric waves." Ges. für Drahtlose Telegraphie. July 10th. (Germany, June 18th, 1918.)

20,508. "Bow collectors for electric railways." C. Conradty. July 10th. (Germany, April 28th, 1916.)

20,510. "Flash lights, &c." Diamond Electric Specialities Corporation. July 10th. (United States, May 2nd, 1918.)

20,536. "Purification of service air for compressors, turbo-dynamos, &c." Deutsche Luftfilter-Bauges. July 10th. (Germany, July 28th, 1915.)

20,552. "Oscillating watt-hour meters." Körting & Mathiesen Akt.-Ges. July 10th. (Germany, June 9th, 1915.)

20,562. "Spark plugs." Champion Ignition Co. July 10th. (United States, November 22nd, 1917.)

20,563. "Spark plugs." Champion Ignition Co. July 10th. (United States, September 25th, 1918.)

20,573. "Process for regenerating energy in direct-current electric motors." Constructions Electriques de Belgique Soc. Anon. July 10th. (Belgium, June 7th, 1919.)

20,574. "Contact finger for rheostats, &c." Constructions Electriques de Belgique Soc. Anon. July 10th. (Belgium, April 2nd, 1919.)

20,580. "Driving systems for alternate-current meters." Dr. P. Meyer Akt.-Ges. July 10th. (Germany, June 12th, 1919.)

20,583. "Electric induction furnaces." W. Grundhofer. July 10th. (Germany, January 21st, 1918.)

20,600. "Spark plug." Champion Ignition Co. July 10th. (United States, March 3rd, 1917.)

20,613. "Ground connections for wireless stations." R. Goldschmidt. July 10th. (Germany, November 8th, 1917.)

20,617. "Ground connections for wireless stations." R. Goldschmidt. July 10th. (Germany, March 22nd, 1917.)

20,632. "Apparatus for rhythmically influencing electric waves produced by cathode tubes." Dr. E. F. Huth Ges. July 10th. (Germany, April 3rd, 1919.)

20,634. "Method of connection for producing oscillations with vacuum tubes." Dr. E. F. Huth Ges. July 10th. (Germany, September 27th, 1917.)

20,635. "Service arrangement for transmitting stations." Dr. E. F. Huth Ges. July 10th. (Germany, September 8th, 1916.)

20,636. "Coin-freed meter for electricity, gas, water, &c." Allgemeine Elektricitats Ges. July 10th. (Germany, July 13th, 1917.)

20,655. "Multiple electric fuses." Neue Industrie Werke. July 10th. (Germany, December 23rd, 1914.)

20,662. "Arrangement for reception of electrical waves." Dr. E. F. Huth Ges. July 10th. (Germany, April 26th, 1919.)

20,667. "Process for distribution of light of electric lamps." F. W. and Dr. C. Killing, Westfälische Gaslühlicht Fabrik. July 10th. (Germany, December 4th, 1915.)

20,676. "Dynamo electric machines." F. H. Schroeder. July 10th.

20,688. "Production of electric carbons." Dynamobürsten-Fabrik Nürnberg-Reichelsdorf Schmidthammer & Magnus. July 10th. (Germany, March 20th, 1918.)

20,701/2. "Machines for manufacture of electric lamps." H. S. Irwin. July 10th.

20,710. "Sparking plugs." Soc. Internationale pour l'Exploitation de la Bougie Sol. July 10th. (France, March 5th, 1918.)

20,717. "Sparking plugs." Soc. Internationale pour l'Exploitation de la Bougie Sol. July 10th. (France, July 15th, 1919.)

20,723. "Interrupting devices for sparking apparatus." R. Bosch Akt.-Ges. July 10th. (Germany, June 1st, 1918.)

20,738. "Electric switches." P. Aufranc. July 10th. (France, July 11th, 1919.)

20,739. "Holders, &c., for electric lamps." Bamberger, Leroi & Co., and K. Gutmann. July 10th. (Germany, February 14th, 1919.)

20,744. "Electric advertising signs." O. Fehler. July 10th. (Germany, June 6th, 1918.)

20,755. "Continuously renewable cathode for anode surface." M. F. L. A Aymard. July 10th.

20,756. "Electrolytic cell." M. F. L. A. Aymard. July 10th.

20,761. "Adjustable ignition means for combustion engines." D. J. Pickee. July 10th. (Germany, February 16th, 1918.)

20,782. "Thermionic valves." H. Morris Airey, A. K. Macrorie, S. R. Mullard, and G. Shearing. July 10th.

20,783. "Use of multiple seals with silica valves, &c." H. Morris Airey, A. K. Macrorie, S. R. Mullard, and G. Shearing. July 10th.

20,784. "Insulation and support of valve electrodes." H. Morris Airey, A. K. Macrorie, S. R. Mullard, and G. Shearing. July 10th.

20,807. "Electro magnetic wave signalling systems." M. Latour. July 10th. (France, December 16th, 1918.)

20,808. "Electro-magnetic direction finding systems." M. Latour. July 10th. (France, December 7th, 1918.)

20,809. "Receiving arrangement for reception of electro-magnetic waves." M. C. A. Latour. July 10th. (France, October 27th, 1916.)

20,810. "Inductances." M. Latour. July 10th. (France, December 12th, 1918.)

20,811. "Telegraphic systems." M. Latour. July 10th.

20,814. "Electromagnetic wave-receiving systems." Soc. Francaise Radio-Electrique. July 10th. (France, November 31st, 1916.)

20,815. "Wireless telegraphy." Soc. Francaise Radio-Electrique. July 10th. (France, October 26th, 1916.)

20,817. "Electrically-driven vehicles." Hansa-Lloyd Werke Akt.-Ges. July 10th. (Germany, July 3rd, 1919.)

20,819. "Railway signalling apparatus." J. Bethenod. July 10th. (France, May 3rd, 1919.)

20,824. "Electric contact device." Ges. fur Nautische Instrumente. July 10th. (Germany, May 11th, 1916.)

20,829. "Electric connecting device for floating or submarine vessels." Neufeldt & Kuhnke. July 10th. (Germany, July 21st, 1916.)

20,831.—"Circuit arrangements of automatic telephone exchanges." Ges. fur Elektromechanische Telephon apparate. July 10th. (Germany, January 10th, 1914.)

20,832. "Sending device for subaqueous sound signals." Signal Ges. July 10th. (Germany, February 6th, 1915.)

20,833. "Submarine sound-signalling apparatus." Signal Ges. July 10th. (Germany, March 18th, 1916.)

20,834. "Signal transmitting devices." Signal Ges. July 10th. (Germany, September 25th, 1917.)

20,835. "Sound transmitting installations." Signal Ges. July 10th. (Germany, October 1st, 1917.)

20,836. "Electro-magnetic sound producers and receivers." Signal Ges. July 10th. (Germany, August 14th, 1918.)

20,837. "Device for adjusting degree of coupling in sound apparatus." Signal Ges. July 10th. (Germany, August 16th, 1918.)

20,838. "Electro-magnetic sound apparatus." Signal Ges. July 10th. (Germany, November 1st, 1918.)

20,839. "Electro-magnetic sound apparatus." Signal Ges. July 10th. (Germany, November 18th, 1918.)

20,840. "Devices for assisting navigation." Signal Ges. July 10th. (Germany, December 27th, 1918.)

20,842. "Sound signalling device." Signal Ges. July 10th. (Germany, April 27th, 1917.)

20,845. "Electro-magnetic sound producers and receivers." Signal Ges. July 10th. (Germany, January 20th, 1919.)

20,846. "Signal transmitting devices." Signal Ges. July 10th. (Germany, September 25th, 1917.)

20,847. "Reception of submarine sound signals." Signal Ges. July 10th. (Germany, January 28th, 1917.)

20,848. "Submarine sound signalling." Signal Ges. July 10th. (Germany, October 1st, 1915.)

20,849. "Submarine sound transmitter. Signal Ges. July 10th. (Germany, May 3rd, 1918.)

20,850. "Receiving device for submarine sound signals." Signal Ges. July 10th. (Germany, May 19th, 1917.)

20,862. "Keyboard telegraph transmitter." J. Gell. July 12th.

20,863. "Telegraph receiving instrument." J. Gell. July 12th.

20,865. "Electric furnaces." B. A. Pilkington. July 12th.

20,877. "Receiving circuits for wireless telegraphy." H. J. J. M. de Regnauld de Bellescize. July 12th.

20,878. "Electro-magnetic wave receiving systems." H. J. J. M. de Regnauld de Bellescize. July 12th.

20,879. "Railway, &c., signalling systems." J. Bethenod. July 12th. (France, December 20th, 1919.)

20,880. "Electro-magnetic wave signalling systems." J. Bethenod. July 12th. (France.)

20,881. "Railway, &c., signalling systems." J. Bethenod. July 12th. (France, April 28th, 1919.)

20,882. "Generator of electric oscillations." Ges. für Drahtlose Telegraphie. July 12th. (Germany, August 7th, 1917.)

20,883. "Electro-magnetic wave-receiving arrangements." Ges. für Drahtlose Telegraphie. July 12th. (Germany, February 8th, 1916.)

20,890. "Secret telegraphic, telautographic, telephotographic, wire, or wireless transmission systems." E. Belin. July 12th. (France.)

20,891. "Thermionic tube relay arrangements." M. Latour. July 12th. (France.)

20,892. "Electrical systems involving three electrode thermionic tube elements." M. Latour. July 12th. (France, December 16th, 1918.)

20,893. "Thermionic tube element arrangement." M. Latour. July 12th. (France.)

20,894. "Telegraphic communication systems." M. Latour. July 12th. (France.)

20,912. "Electric cable attachment." Vulcan Motor & Engineering Co. and C. B. Wardman. July 12th.

20,916. "Automatic, &c., telephone systems." D. A. Christian and Siemens Bros. & Co. July 12th.

20,919. "Paper insulated wire." V. Planer. July 12th. (Germany, July 24th, 1917.)

20,920. "Paper band covering for electric wires." V. Planer. July 12th. (Germany, October 15th, 1917.)

20,921. "Power line for indoor wiring." V. Planer. July 12th. (Austria, November 13th, 1916.)

20,924. "Energy translation connection by vacuum tubes." Dr. E. F. Huth Ges. July 12th. (Germany, October 19th, 1918.)

20,927. "Mono telephones." E. Rumpler. July 12th. (Germany, November, 15th, 1917.)

20,928. "Installation for operation of Röntgen tubes." S. Loewe. July 12th. (Germany, March 5th, 1919.)

20,929. "Arrangement of connections for generating and receiving electrical vibrations." Dr. E. F. Huth Ges. July 12th. (Sweden, July 7th, 1917.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1919.

5,308. "Form of light-intensifier for metal filament electric lamps." E. F. Roberts. March 4th, 1919. (146,558.)

6,067. "X-ray apparatus." M. B. Rodriguez. March 11th, 1919. (146,561.)

6,097. "Wireless and other signalling systems using high-frequency currents." Western Electric Co. (Western Electric Co.). March 11th, 1919. (146,562.)

6,168. "Systems of signalling in fluid media." R. A. Fessenden. March 13th, 1918. (146,563.)

8,198. "Electrode for perforating metal plates." C. J. Holslag. April 1st, 1919. (146,573.)

8,563. "Switchgear for electromagnetic wave transmission and reception systems." P. P. Eckersley. April 4th, 1919. (146,586.)

8,650. "Station sets for intercommunication telephones." R. L. Murray. April 5th, 1919. (146,589.)

8,651. "Station telephone sets for intercommunication telephone systems." R. L. Murray. April 5th, 1919. (146,590.)

8,652. "Driving mechanism for the selector arm of automatic selector switches." R. L. Murray. April 5th, 1919. (146,591.)

9,055. "Electromagnetic wave transmission systems." P. P. Eckersley. April 10th, 1919. (146,610.)

9,157. "Miners' safety lamps and other electric hand lamps." G. Oldham and J. Oldham. April 10th, 1919. (146,615.)

9,186. "Apparatus for forming electric battery elements." H. Wade. (National Carbon Co.) April 10th, 1919. (146,618.)

9,281. "Dynamo-electric machines." Siemens Bros. Dynamo Works and R. H. H. Janzten. April 11th, 1919. (146,624.)

9,294. "Electrical gear for operating bulkhead doors." Harland & Wolff and H. H. Bentley. April 11th, 1919. (146,626.)

13,997. "Electric lamp fittings." C. P. Fairless. June 2nd, 1919. (146,694.)

14,471. "Electric motor and like controllers." H. Crochat. June 6th, 1919. (146,700.)

15,531. "Vacuum tube rectifiers or generators of alternating current especially for use in wireless telegraphy." J. Scott-Taggart. June 30th, 1919. (Cognate application 20,369/19.) (146,708.)

17,243. "Electro-magnetic brake for tramway, railway, and like vehicles." E. Bazley. July 9th, 1919. (146,722.)

17,469. "Electric telegraphs." A. L. Davis. July 12th, 1919. (146,724.)

18,006. "Resistance for electric furnaces." E. Piquerez. February 26th, 1919. (139,448.)

18,734. "High-tension apparatus for use with hot cathode X-ray tubes." A. C. Gunstone. July 29th, 1919. (146,731.)

19,389. "Radio signalling apparatus." Marconi Wireless Telegraph Co. February 7th, 1919. (138,588.)

19,903. "Electric heaters." L. V. Leonard. August 13th, 1919. (146,741.)

21,898. "Automatic electric couplings." R. Belfield (Westinghouse Air Brake Co.). September 5th, 1919. (146,746.)

21,984. "Electrical receiving apparatus, particularly for use in connection with telegraphs and telegraph relays." K. Rahbek and F. A. Johnsen. September 6th, 1919. (Addition to 5,611/19.) (146,747.)

25,466. "Jointing metallic sheathed electric cables." A. E. Wilson and Callender's Cable & Construction Co. October 17th, 1919. (146,763.)

32,602. "Electric coils." M. V. O'Leary. (December 30th, 1918.) (Divided application on 21,807/19.) (146,786.)

1920.

1,959. "Brade magnets for electricity motor meters." J. Harris. (May 7th, 1919.) (Divided application on 11,433/19.) (146,794.)